CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERING AND CONSTRUCTION

Unique structure for radiation testing takes shape at Oak Ridge National Laboratory. See article by Gibson Morris.

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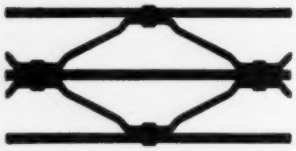

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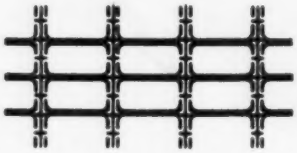

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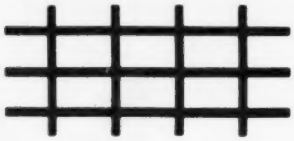

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BORDEN *first* IN FLOOR GRATING

USES OF GRATING . . . WHERE ONLY BORDEN QUALITY WOULD DO . . .

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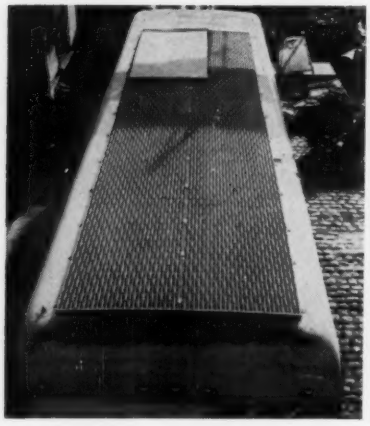
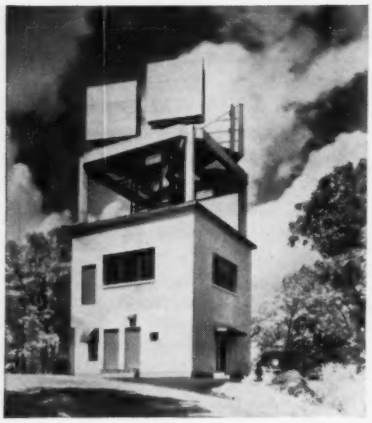
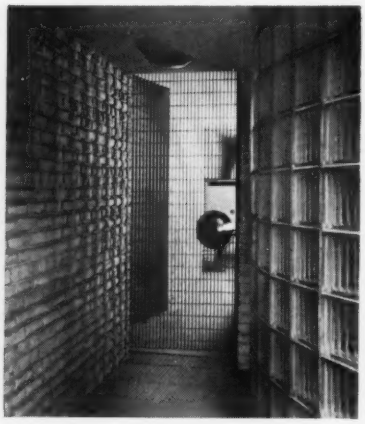


Wherever this Color Television truck goes, whatever the assignment of the reporters who must mount its roof, Borden riveted *serra-crimp* grating will mean surerfooting —even in ice or snow.



Television relay stations and radar stations that gird our continent have adopted grating as standard outside platform material. It will not collect snow as most other platforms will.



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SEPTEMBER 1956
VOL. 26 • NO. 9

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• ARTICLES

Edward M. Browder	41	**Increasing the capacity of the Panama Canal**
Gail A. Hathaway	45	**Basin-wide, multiple-purpose planning of our water resources**
P. S. A. Berridge, Donovan H. Lee	48	**Prestressing restores weakened truss bridge in Birmingham, England**
A. George Mallis	50	**Economy plus architectural appeal with tilt-up construction**
C. E. Painter	52	**Seven-million-dollar water works serves less than a thousand people**
B. E. Torpen	56	**Large rocks in river control works**
Wallace F. Tate	62	**Smokeless flare solves propane disposal problem**
E. Paul Lange	66	**Affiliate membership in EJC evaluated**
Gibson Morris	68	**Tower for radiation testing meets unusual requirements**
Bonner S. Coffman	71	**Finding the interval between dates**
Frederick R. Heartz	72	**Two-way slab design simplified by tabulation**
A. Pikoos	73	**Metal lining fastened with power-driven studs**

• SOCIETY NEWS

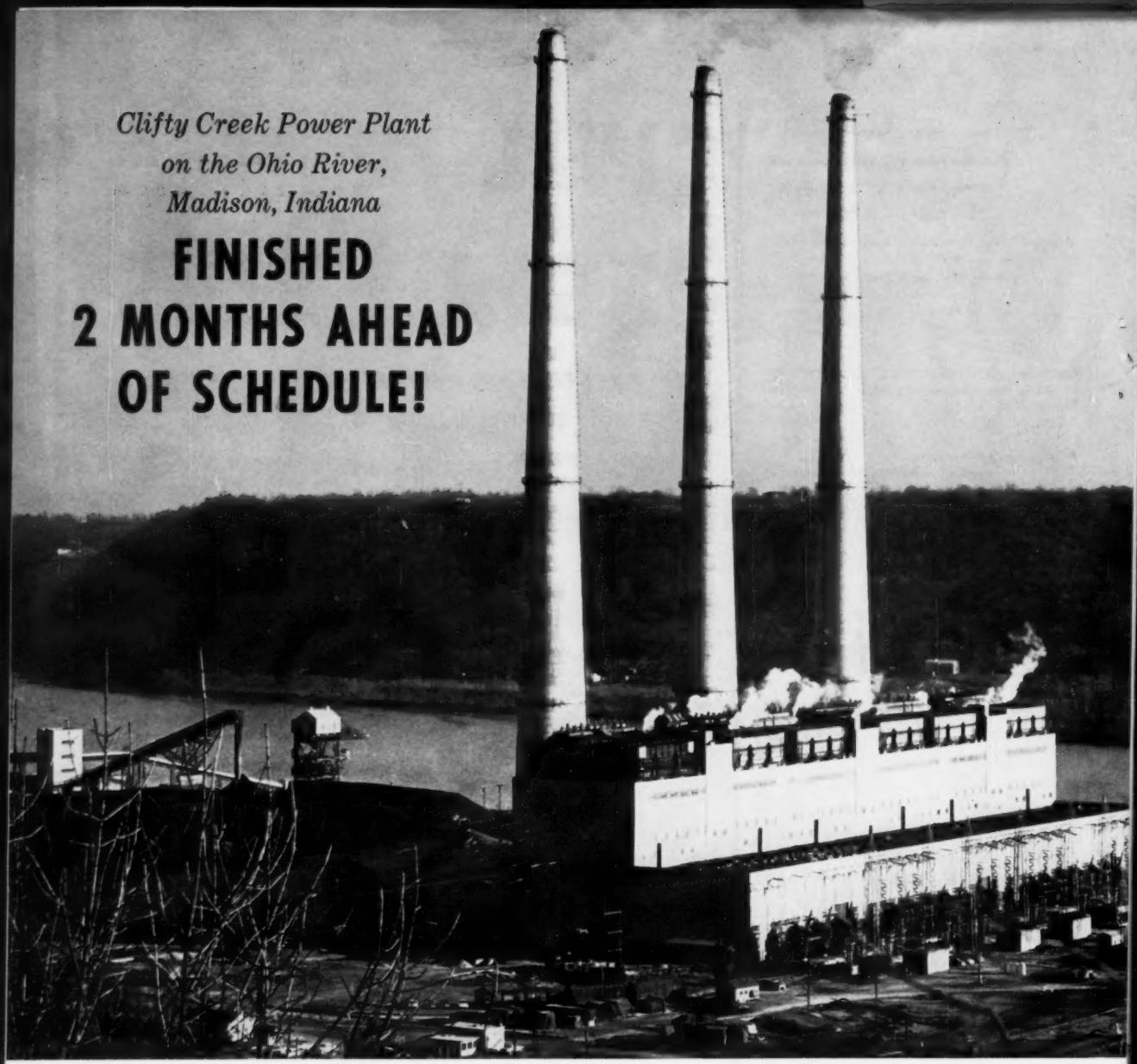
75	**PROGRAM of ASCE Annual Convention in Pittsburgh**
87	**Last call for ASCE Convention**
87	**Mexico City to be host to Fourth UPADI Convention**
88	**Topic for new Daniel Mead Contest announced**
88	**ASCE urges selection of experienced Highway Administrator**
88	**Second Nuclear Congress slated for Philadelphia**
90	**Notes from the Local Sections**

• NEWS BRIEFS

96	**July construction hits new seasonal high**
97	**More water for Caracas, booming capital city**
99	**Driving of piles for huge Camden Dock completed**
100	**Industrial laboratory with a future**
102	**New civil engineering projects in colonial countries**

• DEPARTMENTS

28	News of Engineers	110	Non-ASCE Meetings
39	Do You Know That	114	New Publications
71	Engineers' Notebook	116	Applications for Admission
73	Field Hint	130	Men and Jobs Available
74	The Readers Write	136	Equipment, Matrls, Methods
89	Scheduled ASCE Meetings	144	Literature Available
104	N. G. Neare's Column	145	Films Available
106	Deceased	146	From the Manufacturers
108	Positions Announced	152	Index to Advertisers
147	**Proceedings Papers Available**		



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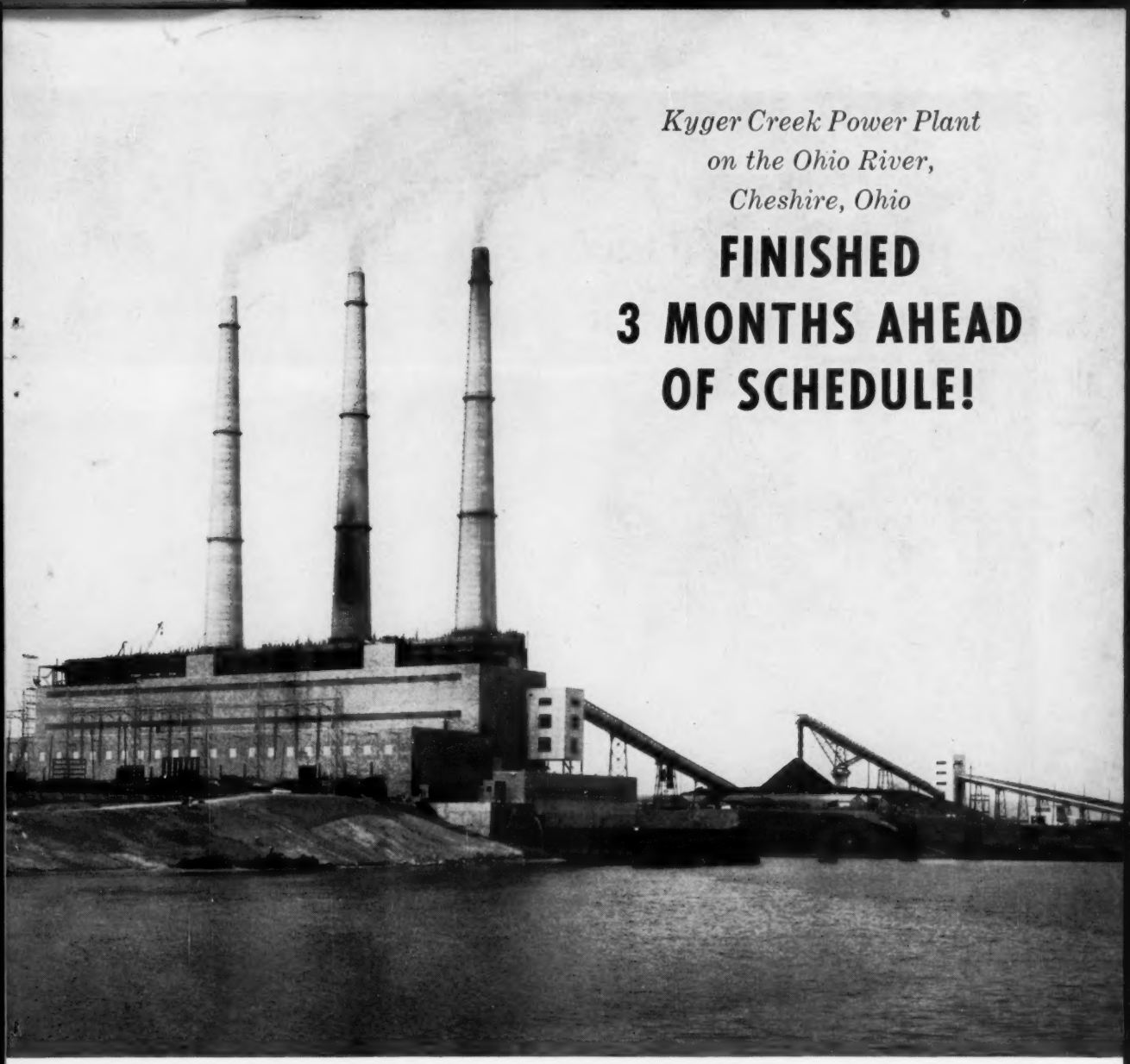

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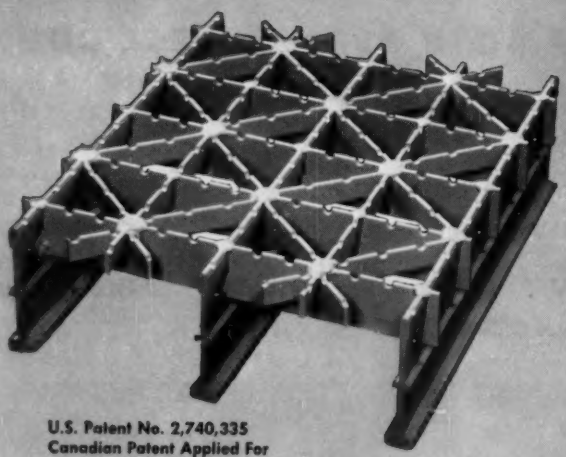

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Integrally connected triangles extend over entire roadway insuring maximum lateral or horizontal rigidity and high skid resistance. They are especially adaptable for reflooring old bridges. Solid units remain true during shipment, handling and erection. Test data available proving resistance to distortion. Grids made in lengths up to 42 feet and 7 feet 3 inches standard widths to reduce number of units to be handled and field splices to be made between grids.

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This flooring is now being produced in our large, modern production plant, and a large reserve supply of materials is on hand to insure prompt delivery. For further information, write to

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Special Representative

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We want to make a few comments on our experience with the use of Greulich Bridge Flooring on Lanier Bridge. From the field point of view we find your grating advantageous in several ways. The larger units meant fewer pieces to handle and fewer splices to weld. The 7-1/2 inch spacing of main members meant fewer welds to supporting steel.

We would like to make a comparison between your grating and that of another design on a neighboring bridge. The intensity of hum as rubber-tired cars cross the bridge is of concern to those who must hear it. The hum from your grating is only a small fraction of that of a competing type, a strong selling point in our estimation.

You can be sure that we will again give serious consideration to the use of Greulich Grating on our next bridge where grating is specified.

Yours very truly,

BRISTOL STEEL & IRON WORKS, INC.

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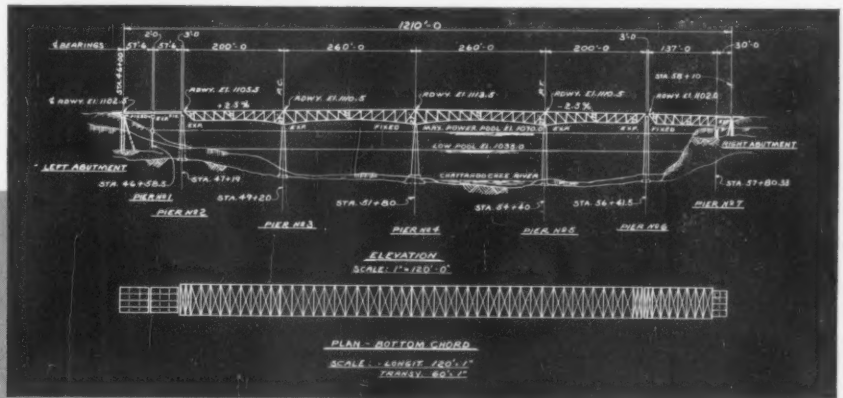

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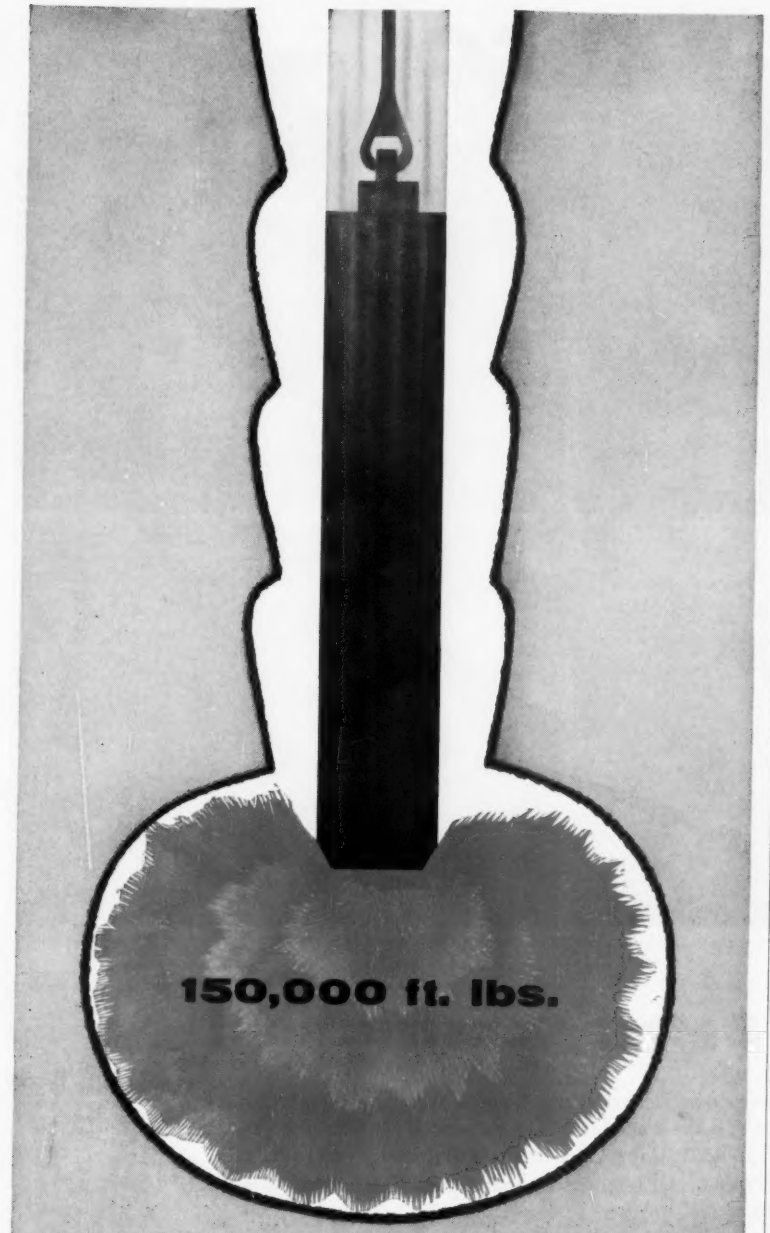

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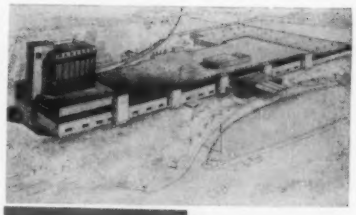

FRANKI FACTS

In preparing foundation designs for their new bakery at Fair Lawn, New Jersey, National Biscuit Company's engineers decided to support the light loads at the packaging department and shipping room areas on shallow piers resting on spread footings. For the heavily loaded areas of the plant, the eight and three-story portions housing the bins for storage of raw materials and the bakery operations, the owner invited proposals based on various types of cast-in-place piles and on Franki Displacement Caissons. After careful consideration, the Nabisco engineers chose the Franki Displacement Caisson design on the basis of its structural soundness, economy and speed of installation.

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A total of 407 standard displacement caissons were installed. No reinforcing steel was used in the caisson shafts. Once again Franki Displacement Caissons developed adequate load capacity at relatively shallow depths whereas it would have been necessary to drive friction piles to a much greater penetration in order to develop sufficient frictional resistance.

The Engineering Department of National Biscuit Company prepared the building design and Walter Kidde Constructors, Inc. is the General Contractor for the project.

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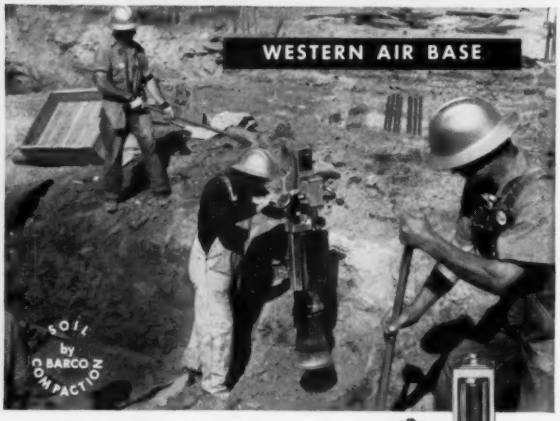

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One of the biggest advantages offered by Barco Rammers is ability to handle work in minimum time. On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24″, the rate for 18″ trench is 360 to 600 feet per hour.

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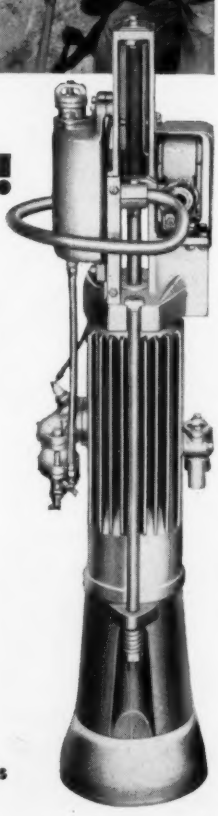

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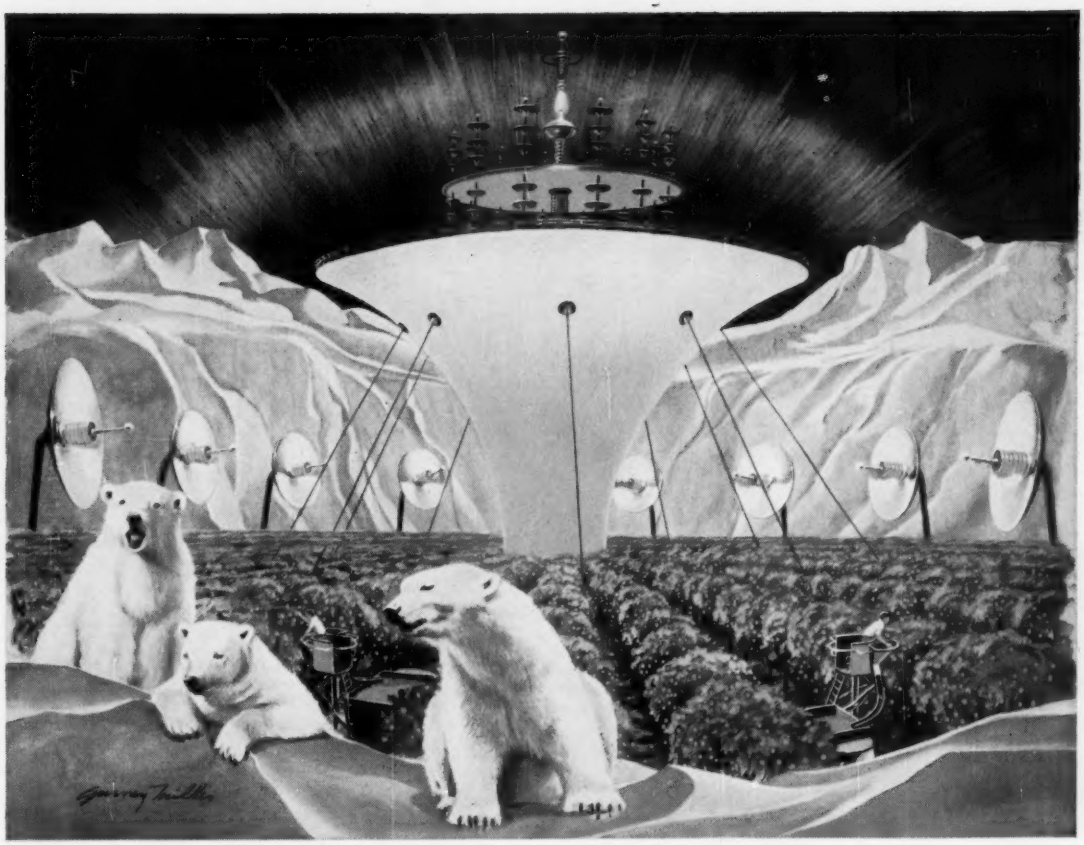

Huge solar engines imprisoning the heat of the sun may create islands of fertility in icy wastelands, thus vastly increasing the productive food areas of the earth.

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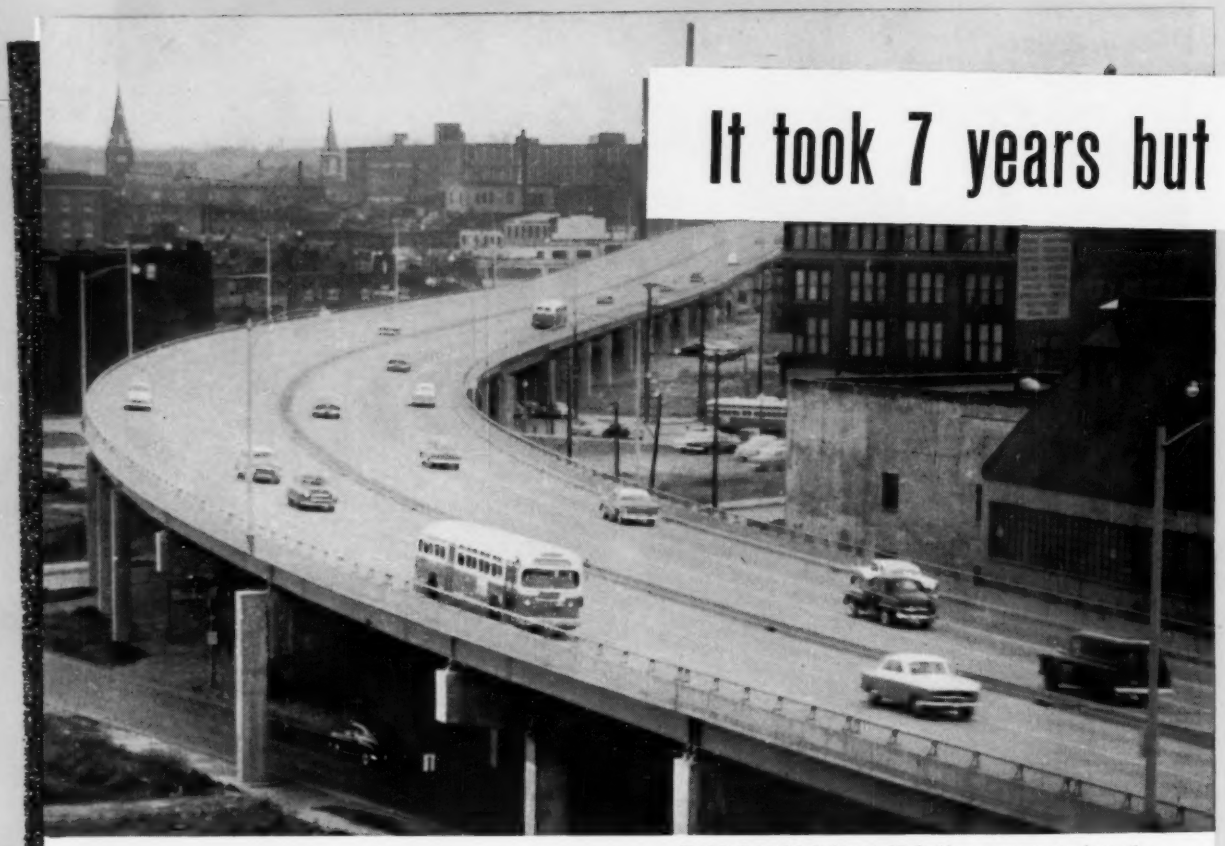

This 1.7-mile stretch is the first part of St. Louis' new expressway system in operation.

HOW TO GET THREE MORE HOURS A WEEK AT HOME

Follow the lead of Larry Wood and his fellow commuters in St. Louis. They voted themselves the time. How? It's a result of Missouri's 10-year highway program

Larry Wood spends 90 minutes a day on a bus—going to his St. Louis office in the morning and returning to his suburban home at night. And Larry is *typical*—for buses carry *half* the people going into the downtown area. What's more, traffic congestion has been getting steadily worse.

But last year, St. Louis commuters had a chance to cut traveling time as much as 40% by putting an "X" on a ballot. They helped pass a bond issue which will produce multiple-lane expressways coursing right into center city. All these limited-access highways are designed to carry buses as well as automobiles. Result: Larry's bus trip will be cut an estimated 18 minutes each way. That's 150 hours a year—over six full days! He can stay in bed later—get home in time to play with the children. Motorists will have even more time.

The expressways are part of Missouri's model 10-year highway program started in 1952. In urban areas, state and federal money pays for everything but half the cost of acquiring right-of-way. The local bond issue, which Larry helped pass, will pay that. In 10 years, Missouri will spend more than a half-billion dollars building roads: expressways in urban areas, highways between cities, and 12,000 miles of additional farm-to-market roads. Federal Interstate Highway Aid will help. (Missouri spent more than $3½ million last year on surveys to take immediate advantage of the new Federal program.) But overall road improvement is still a state responsibility.

Good roads save far more than they cost—in time, in lives and in actual cash. To find how you can help the road program in your own state, write for the free booklet, "Road Block." Address Dept. 9, Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

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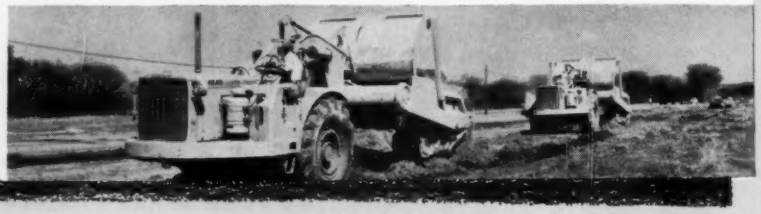
EARTHMOVING EQUIPMENT

Wherever you see Caterpillar machines working on your roads, you can be sure your state is getting its money's worth.



helped you get a 41,000-mile highway job

THE big, overriding reason that the Federal government is going to spend $32,900,000,000 to build highways during the next 13 years is that the people demanded it. Not only that, they are willing to pay for it.

One of the important forces that helped mold this powerful public demand was a continuous seven-year advertising campaign by Caterpillar to promote good roads. Like the advertisement on the opposite page which appears in *The Saturday Evening Post* in September in full color.

Now the money has been voted. Contracts are being awarded today to get the huge program rolling. Once again you and Caterpillar are going to be partners in progress—this time on the biggest public works jobs in history. And Caterpillar is better prepared to help you than ever before.

For during the seven years that this advertising has appeared, Caterpillar has sponsored an intensive research and development program. Result: today it has the most complete line of high-production, cost-cutting earthmoving machines in the world. And there are new and improved models all down the line. Tractors, Traxcavators*, Motor Graders, Engines and Electric Sets. They're ready to give you greater production, lower operating costs, and surer profits in the big job ahead.

The CAT* DW21 Tractor (Series C) and its matching No. 470 LOWBOWL Scraper is just one example. Today this unit is powered by a 300 HP (maximum output) Caterpillar Engine with Turbocharger. Its big, new wide-section tires add flotation and traction to save on tires and maintenance.

Add to this the new LOWBOWL Scraper, designed to load 18 cu. yd. struck or 25 cu. yd. heaped, and you have faster loading, bigger loads, faster cycle times . . . *and bigger profits.*

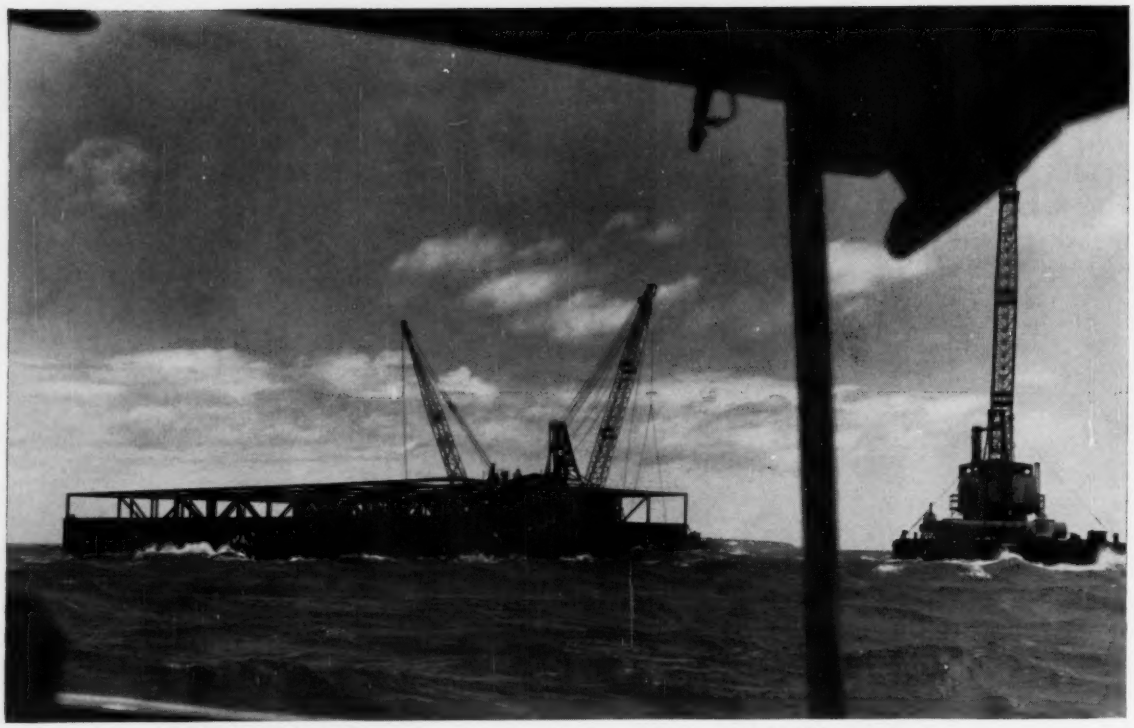
Caterpillar—and your Caterpillar Dealer—are proud that the big yellow machines are the world's No. 1 road building equipment. But prouder still that they won that leadership in the field . . . working in partnership with you.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

LEADERSHIP IN ACTION



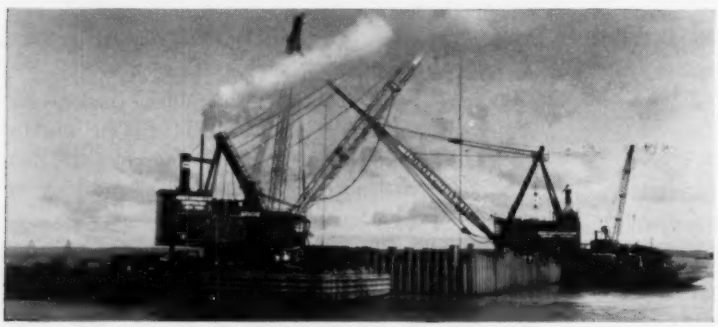
Largest sheet-piling cofferdam was for pier No. 22 which, when completed, contained 85,000 cu yd of concrete. Piling contractor was Merritt-Chapman & Scott Corp., New York City. *Bridge owner:* Mackinac Bridge Authority.

Rough Water, Adverse Weather Marked Placing of Cofferdams for Mackinac Bridge Piers

Together with the approaches the Mackinac Bridge, now under construction, will be approximately five miles long. It will cross the Straits of Mackinac, four miles of open water between St. Ignace and Mackinac City in northern Michigan. The straits vary in depth from only a few feet to nearly 300 ft and are characterized by strong currents and are subject to severe weather conditions. As a result, construction of the piers for the Mackinac Bridge was an unusually difficult operation.

Of the 33 water piers for the bridge, 30 were built in open cofferdams, either rectangular or circular, constructed with Bethlehem steel sheet-piling, internally braced with steel frames. For the rectangular cofferdams, Z-pile section ZP27 was used, the maximum depth to rock being 101 ft below water level for one of the piers. Straight-web sheet-piling SP6a was used for the circular piers, the sheet-piling being driven to a maximum depth of 99 ft below water level in one cofferdam. The remaining three water piers were built in open-dredged caissons.

All sheet-piling for cofferdams was left in place to add permanence to the concrete. At the two anchorage piers, the piling was cut off at El + 10 ft, to serve as armor against abrasion by ice. Bethlehem supplied a total of over 5000 tons of steel sheet-piling for the construction of the Mackinac Bridge piers.



Dredging overburden from anchorage pier. Here sheet-piling was cut off at El + 10 ft to allow piling to act as armor against abrasion by ice.

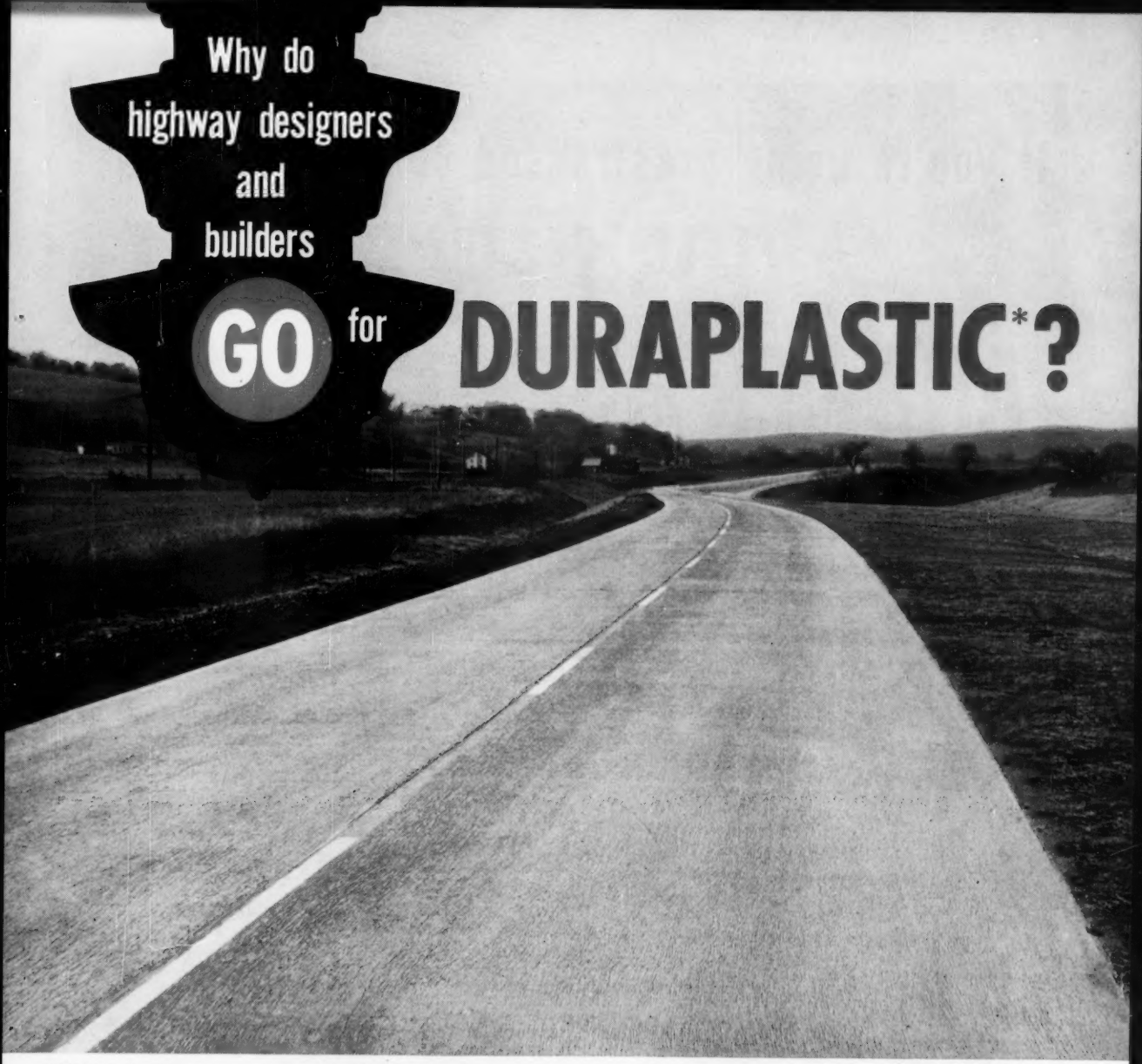
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Why do highway designers and builders GO for DURAPLASTIC*?



WORKABLE, PLASTIC concrete mixes made with Atlas Duraplastic Cement helped speed construction on New York State Highway, Fort Plain, N. Y.

because this concrete looks better, lasts longer!

When paving must be placed fast, highway designers and builders prefer Atlas Duraplastic cement because it makes a more plastic, more cohesive concrete that dumps, spreads and finishes easily. Also, bleeding and segregation are minimized, permitting finishing closer to the paver and earlier curing.

Besides improving workability, Atlas Duraplastic Air-Entraining Portland Cement gives concrete greater durability . . . fortifies it against freezing-thawing weather and scaling caused by de-icing salts.

YET DURAPLASTIC COSTS NO MORE than regular cement—requires no unusual changes in procedure.

Complies with ASTM and Federal Specifications. For descriptive booklet, write:

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL (USS) CORPORATION SUBSIDIARY

100 PARK AVENUE, NEW YORK 17, N. Y.

*"DURAPLASTIC" is the registered trade-mark of the Air-Entraining Portland Cement manufactured by Universal Atlas Cement Company.

AIR-ENTRAINING PORTLAND

Atlas® Duraplastic Cement

D-188

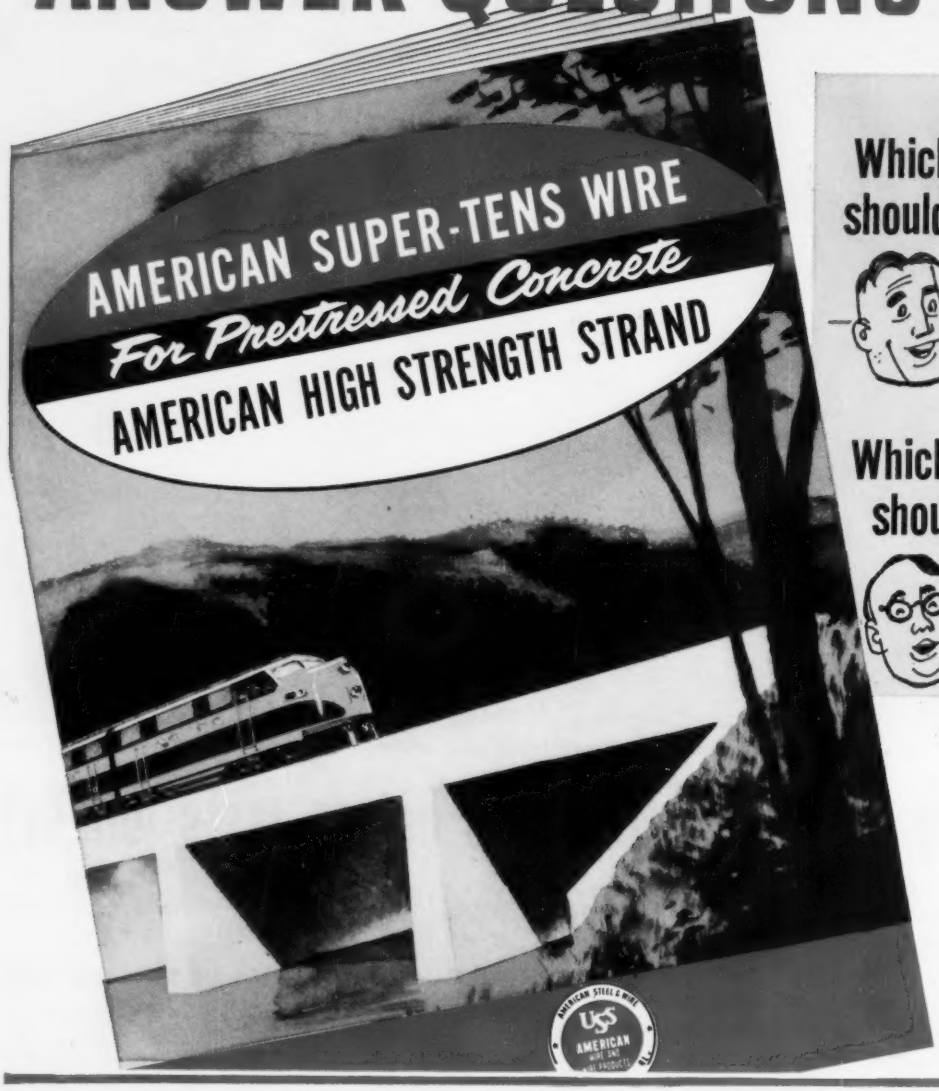
MAKES BETTER CONCRETE AT NO EXTRA COST

OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

United States Steel Hour—Televised on alternate Wednesdays—See your local newspaper for time and station.

If you're using prestressed concrete...

THIS NEW BOOKLET ANSWER QUESTIONS LIKE


AMERICAN SUPER-TENS WIRE
For Prestressed Concrete
AMERICAN HIGH STRENGTH STRAND
Which WIRE should I use?
Which FITTINGS should I use?

USS AMERICAN *Super-Tens* WIRE & HIGH

HELPS THESE

SEND THIS COUPON FOR A FREE COPY. This new 16-page booklet describes the complete line of high strength wire, high strength stress-relieved strand, and end fittings manufactured by American Steel & Wire. It contains stress-strain curves, typical tensioning loads and breaking strengths for American Super-Tens Wire and American High Strength Strand—quality products that are especially made for use in prestressed concrete. Send for your copy.

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Please send your new descriptive booklet on American Super-Tens Wire and American High Strength Strand for prestressed concrete. Also send information on these other products of American Steel and Wire:

- ☐ American Welded Wire Fabric for Portland Cement Concrete
- ☐ American Welded Wire Fabric for Asphaltic Concrete
- ☐ American Welded Wire Fabric for Airport Runways
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STRENGTH STRAND

UNITED STATES STEEL

Layne Research

7 ways it serves and saves

1 FIELD CONSULTATION: Expert technicians, trained and experienced in all phases of ground water development, are available to Layne clients through Layne associate companies.

2 TRAINING LAYNE PERSONNEL: Layne field operators are trained in new techniques and in the use of materials proved in practical applications as well as in the laboratory.

3 CORROSION PREVENTION: Rust and other corrosion prevention, through the use of properly selected materials for well casings, screens and pumps, including cathodic protection by sacrificial metals and the use of tested resistant paint coatings, are major research developments.

4 REHABILITATION OF EXISTING WELLS: Major expense is often avoided by rehabilitating existing wells and developing new wells by methods initiated in the Research Division.

5 SELECTION OF WELL SCREENS TO WELLS: Well screens, gravels and formation sands are correlated to secure maximum trouble-free water productions with a minimum of screen losses, as the result of Layne Research.

6 IMPROVED WELL CONSTRUCTION TECHNIQUES: Work of the Research Division has resulted in many new materials, including Laynite well cements for sealing well surface casings, Laynite additives for treatment of wells, and Laynite rotary drilling muds.

7 ANALYTICAL STUDIES: Basic research determining corrosion causes, deposition of minerals, micro-bacterial growths, effects of dissolved gases and remedial treatments, is an ever-continuing subject for the Research Division.

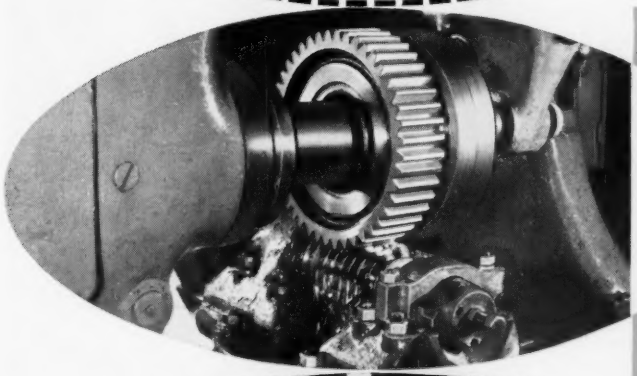
Layne — Industry — Municipality — Agriculture

Water Wells • Vertical Turbine Pumps
Water Treatment

LAYNE & BOWLER, INC.
MEMPHIS
General Offices and Factory
LAYNE ASSOCIATE COMPANIES
THROUGHOUT THE WORLD

Important reasons why it pays to use *True Original Parts*

Allis-Chalmers True Original Parts start right. Each benefits from one of industry's most intensive metallurgical research programs. And each is designed by experienced construction machinery engineers to do a specific job . . . with ample capacity to carry a full share of the work load just as the new equipment part did.



1

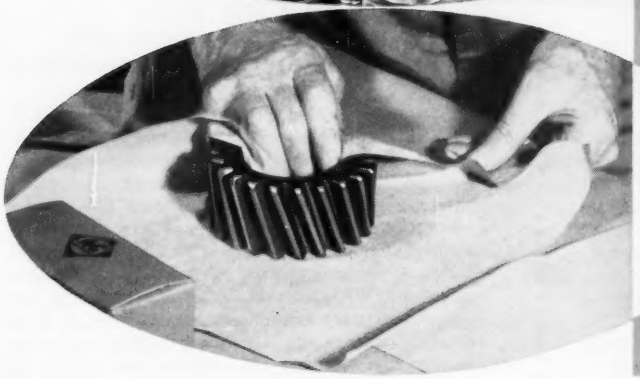
PRECISION-MADE

Skilled craftsmen bring True Original Parts to life—working with the most modern manufacturing equipment and meeting the highest industrial standards. The result: precision-made parts get full work power from your Allis-Chalmers machinery.

2

CAREFULLY INSPECTED

True Original Parts go through rigid original-equipment inspection and testing processes to assure long-life service. For example, gears are checked again and again for perfect meshing . . . for true balance . . . for full capacity.



3

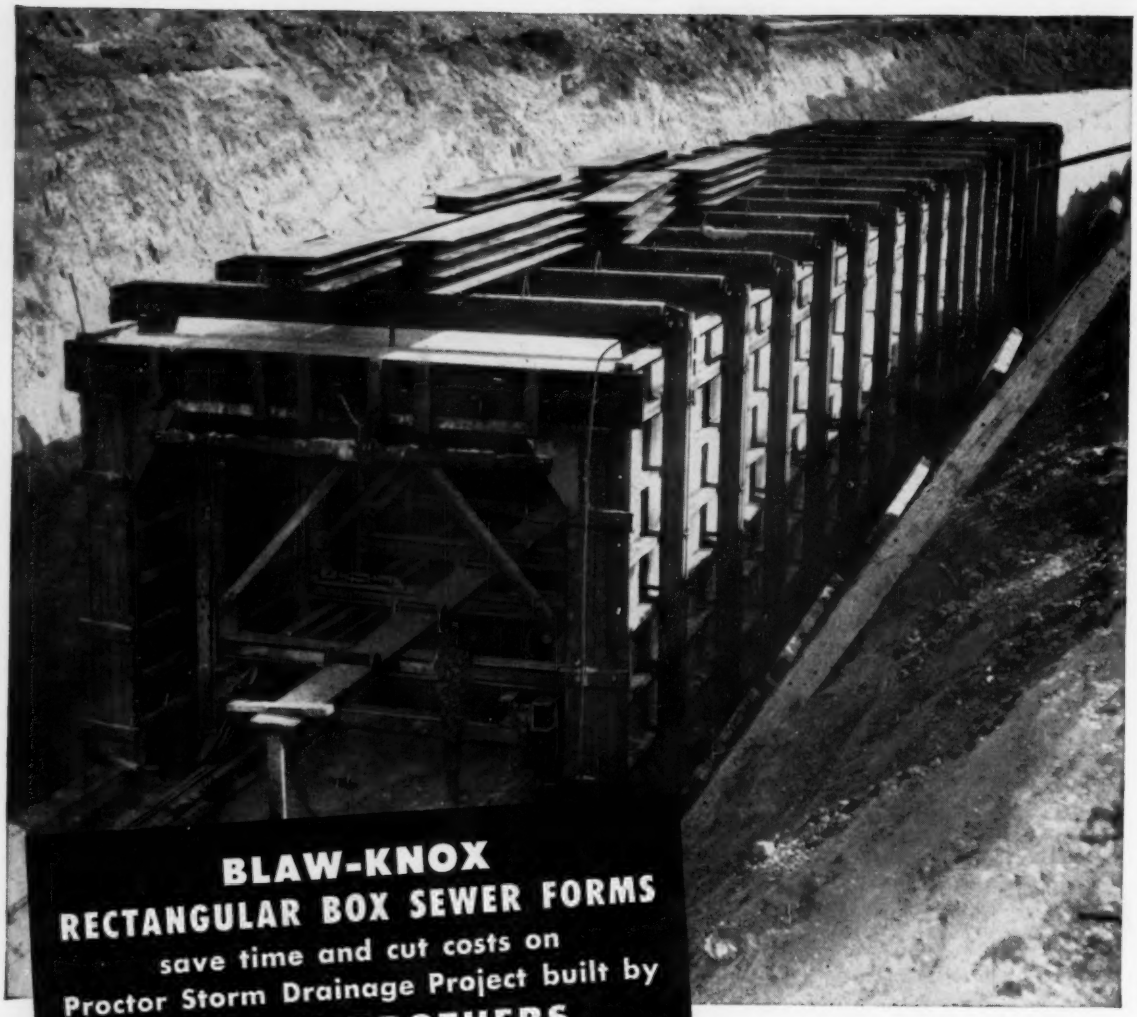
PROPERLY PACKAGED

You want your parts factory-new . . . and that's how you get True Original Parts. Many are specially treated . . . then sealed and packaged against rust, dust and damage.

A country-wide network of dealers stock ample supplies of True Original Parts. Whether you're working in one area or across the country, you can depend on reliable parts service close to your job from your Allis-Chalmers Construction Machinery dealer.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS



BLAW-KNOX RECTANGULAR BOX SEWER FORMS

save time and cut costs on Proctor Storm Drainage Project built by

SLOVAK BROTHERS

Corpus Christi, Texas

■ Here's another typical example of Blaw-Knox Steel Form Engineering which allowed this Corpus Christi general contractor to average daily pours of 80 feet on 10-ft. wide sewers, and meet all job specifications. The Proctor Storm Drainage Project required 1,710 feet of sewage conduit 10′ wide by 9′ high; 1,722 feet 10′ x 8′; and 2,843 feet 8′ x 7′, for a total length of 6,275 feet. One set of Blaw-Knox special rectangular box type adjustable forms easily handled the three sizes of conduit. The unique feature of the project was the system devised by Blaw-Knox engineers for supporting the conduit roof during pouring and curing. By using four sets of cross beam supports tied together with the outside forms, Slovak Brothers maintained a continuous pouring pace with one set of forms.

PLAN YOUR JOBS WITH BLAW-KNOX STEEL FORMS AND BLAW-KNOX CONSULTATION SERVICE

Cut *your* concreting costs by consulting Blaw-Knox in the preliminary planning stage of your next job. Blaw-Knox engineers have undoubtedly solved similar problems and saved money for other contractors, so by taking full advantage of the Blaw-Knox Steel Forms Consultation Service, you are assured of recommendations and proposals for the most efficient concreting methods and the most economical forming equipment. With over 40 years' experience as the original and most prominent manufacturer of Steel Forms, Blaw-Knox specializes in helping you plan for the simplified forming that builds your profits by keeping costs low. Write for details today.

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STEEL FORMS DEPARTMENT • BLAW-KNOX EQUIPMENT DIVISION

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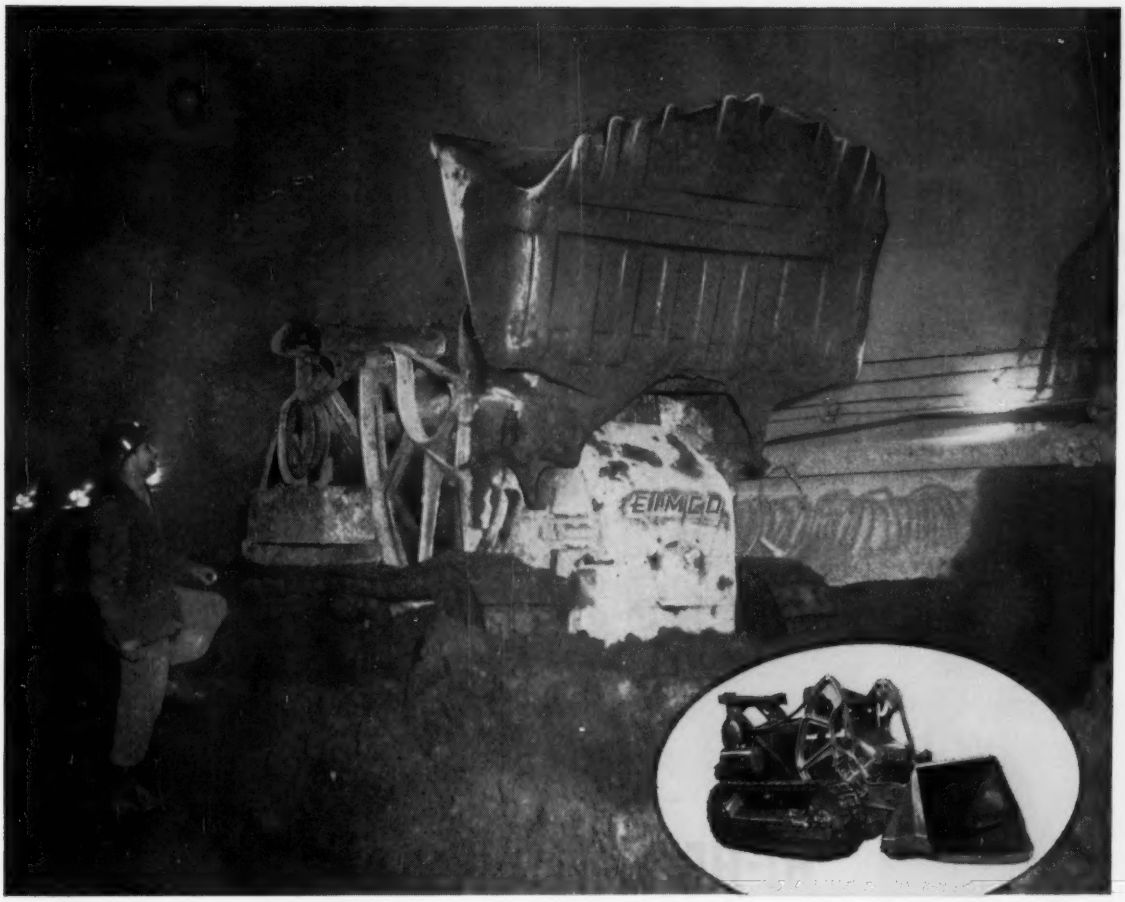
50th Anniversary BLAW-KNOX 1906-1956

BLAW-KNOX STEEL FORMS CONSULTATION SERVICE



QUEBEC HYDRO-ELECTRIC COMMISSION USES EIMCO 105 TRACTOR-EXCAVATORS ON BERSIMIS PROJECT

The Quebec Hydro-Electric Commission supplied contractors on the huge Bersimis project with several Eimco 105 Tractor-Excavators as the most efficient machines available for certain phases of the job.

Eimco 105's worked on the penstocks at the powerhouse, loaded blasted rock at the diversion tunnel, mucked in the intake shafts, assisted in clean up of the main tunnel, loaded aggregate from the quarries and accomplished numerous other jobs including, (as shown above) the takeup of the bottom in the main tunnel.

The main tunnel bore at Bersimis is 7 miles long and excavated diameter was 45 feet. The intake shaft on the Diversion tunnel was 32 feet in diameter by 120 feet deep. The Bersimis project is scheduled to generate power by July or August of 1956.

Contractors have worked steadily in the face of adverse weather conditions to complete this great work at an early date. Eimco extends its heartiest congratulations on a job well done.

Eimco 105 Tractor-Excavators are at work throughout the world on Hydro-electric development projects, mines, roadbuilding, stockpile loading, pits and quarries and many other rough jobs. In many instances, the 105 is the only production equipment on the job—because its dependability is a well known and proven fact.

If your project calls for a tractor, bulldozer, or excavator, you'll want Eimco to supply you with full information about the versatile 105. Just send details of your project. You'll find, as have many others, that Eimcos will do the job faster, cheaper and better.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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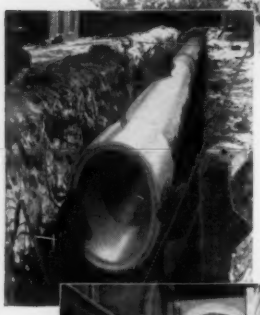

HI-HED makes a perfect utility gallery. Pre-cast HI-HED units speed installation and cut construction costs.

HI-HED REINFORCED CONCRETE PIPE

Deep cuts and high fills are often encountered in maintaining the minimum grades which are consistent with good highway design. In the past, drainage structures under high fills have proved delaying, cumbersome and costly. But now, American-Marietta offers you a practical solution—HI-HED Reinforced Concrete Pipe with *50% greater strength than its round pipe equivalent.*

When used as storm or sanitary sewers HI-HED permits greater self-cleansing velocities in dry weather periods. In urban areas HI-HED makes full use of available cross-room without disturbing existing utilities. Find out more about HI-HED, the stronger, versatile, elliptical pipe that's destined for an important role in the multi-billion dollar highway program. Write today.

Our technical staff will be pleased to assist you with your pipe problems.

AMERICAN-MARIETTA COMPANY
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For the first time, draftsmen can work in SEATED COMFORT

Boost drafting room morale with the new **GF Draft-a-Matic®**

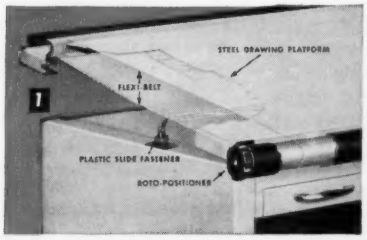
Now . . . instead of standing, stooping, stretching, perching on the edge of a stool . . . the draftsman can remain comfortably seated in an adjustable office chair while Draft-a-Matic's exclusive Roto-Positioner brings all parts of his drawing within easy working range. This increases efficiency by reducing fatigue, improves morale by providing greater working comfort.

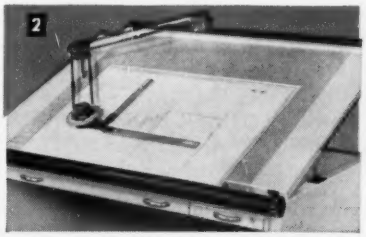
Increased productivity is just one of the reasons why engineering costs go down when you install Draft-a-Matic.

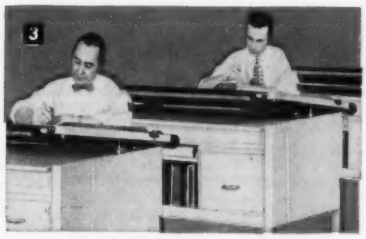
Find out for yourself the many reasons why Draft-a-Matic has made conventional drafting desks obsolete, and specifically what it can do for you. See it now at your local GF showroom – look in the Yellow Pages – or write for free 8-page Draft-a-Matic booklet. The General Fireproofing Company, Dept. C-58, Youngstown 1, Ohio.

THESE FEATURES MAKE **DRAFT-A-MATIC** *WORLD'S FINEST*

- All metal construction with baked-on finish. No warping.
- Velvoleum covered drafting platform adjustable 0 to 85°.
- Height of entire unit adjustable from 31" to 39" at 1" intervals.
- Large center drawer with locking instrument tray.
- Shelf and storage drawer arrangements to suit individual needs.
- Large sliding reference shelf for extra convenience.
- Designed for space-saving row installation.
- Accommodates parallel straight edge, drafting machine, lamp.
- Exclusive Flexi-Belt and Roto-Positioner delivers the work to the man.







1. Drawing is affixed to endless vinyl plastic belt. By merely turning Roto-Positioner wheel, draftsman moves drawing into working range while remaining comfortably seated.

2. Draft-a-Matic will accommodate drafting machine, parallel straight edge, lamps and similar accessories. Drawing platform is covered with Mist Green Velvoleum.

3. Row arrangement creates a complete work station in only 32 square feet. Immediately behind draftsmen are drawers and shelves for reference material and a handy sliding work shelf.

MODE-MAKER DESKS • GOODFORM ALUMINUM CHAIRS
SUPER-FILER MECHANIZED FILING EQUIPMENT • GF ADJUSTABLE STEEL SHELVING

GF metal business furniture is a **GOOD** investment

GF
GENERAL FIREPROOFING
Foremost in Metal Business Furniture

when you're contemplating construction...

remember this picture!

If you are planning to build in an area that may possibly be affected by flood conditions, your best insurance is dependable foundation construction. While replacing stock and equipment as a result of flooding is certainly not a simple task, it is nothing compared to the repair or reconstruction cost of a complete building or plant.

For over half a century, we at Raymond have been specializing in all types of foundation work under every conceivable condition. In the recent storms in the Northeast, a number of structures resting on Raymond Piles were flooded. (One of these, the Stacey War Memorial Building in Trenton, is shown above). NONE OF THE BUILDINGS ON RAYMOND FOUNDATIONS IN ANY OF THE FLOOD AREAS WAS MOVED A FRACTION OF AN INCH, even though some of the surrounding structures were swept away.

We'll be happy to apply our experience to your foundation problems, whether they're large or small, routine or unusual. Remember, Raymond foundations are *permanent*.

THE SCOPE OF RAYMOND'S ACTIVITIES

IN THIS COUNTRY
Foundations . . . Marine Structures . . .
Heavy Construction . . . Soil Investigations

OUTSIDE THE UNITED STATES
Complete service for all types of construction

RAYMOND CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

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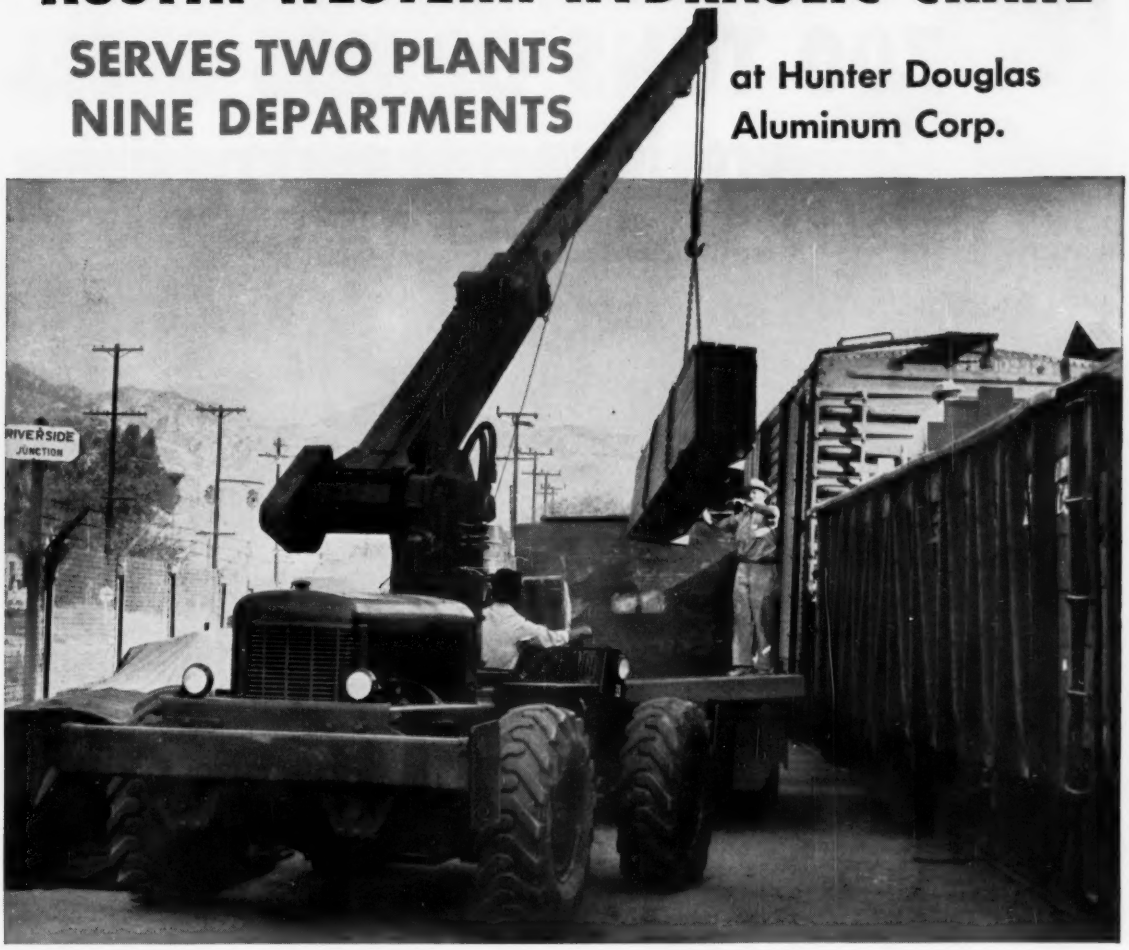
AUSTIN-WESTERN HYDRAULIC CRANE

SERVES TWO PLANTS NINE DEPARTMENTS

at Hunter Douglas Aluminum Corp.



Effects Savings in Manpower, Time, Avoidance of Outside Jobs, Shipping and Maintenance Labor

Here's What They Say—"This hydraulic crane with its 18' extensible boom and 6' manual extension, its compact design, large tires to grip the ground and 4-wheel power steer for maneuverability soon showed other departments the economies to be made with the A-W when it is not required by shipping. This versatile tool has served 8 or 9 departments since January, 1955.

"Our people had watched a 20-ton crane with a similar rake used for the same purpose. The economy was soon evident of using instead an inexpensive 5-ton capacity crane which proves it has ample power for the operation.

"This hydraulic crane is well suited to handle pipe high overhead as well as in trenches or about the grounds. The crane raises space heaters and assists the men to replace roof sections damaged by acid fumes. It unloads steel beams, bars and deck roofing from cars on the switch track or at the junction or from trucks at the platform. With its towing hook it pulls cars on both our long sidings and spots them where required. It unloads aluminum ingots from gondola cars and stacks them—a job for which we formerly rented a large crane for $10.25 an hour.

"The precision of this hydraulic unit is particularly desirable in raising prefabricated or welded pipe arrangements into place in the plant.

"In construction and maintenance, the Austin-Western unit does an excellent job of pouring concrete as it comes out of the Redi-mix truck, and the pouring can just as well be two or three stories in the air."

For the complete story, ask for Gould Certified Report No. 5603.

BALDWIN BLH LIMA-HAMILTON

AUSTIN-WESTERN WORKS

BALDWIN-LIMA-HAMILTON

Construction Equipment Division

OTHER DIVISIONS: Eddystone • Lima • Electronics & Instrumentation • Hamilton • Loewy-Hydropress • Standard Steel Works • Madsen • Pelton

AUSTIN-WESTERN WORKS
629 Farnsworth Avenue, Aurora, Illinois

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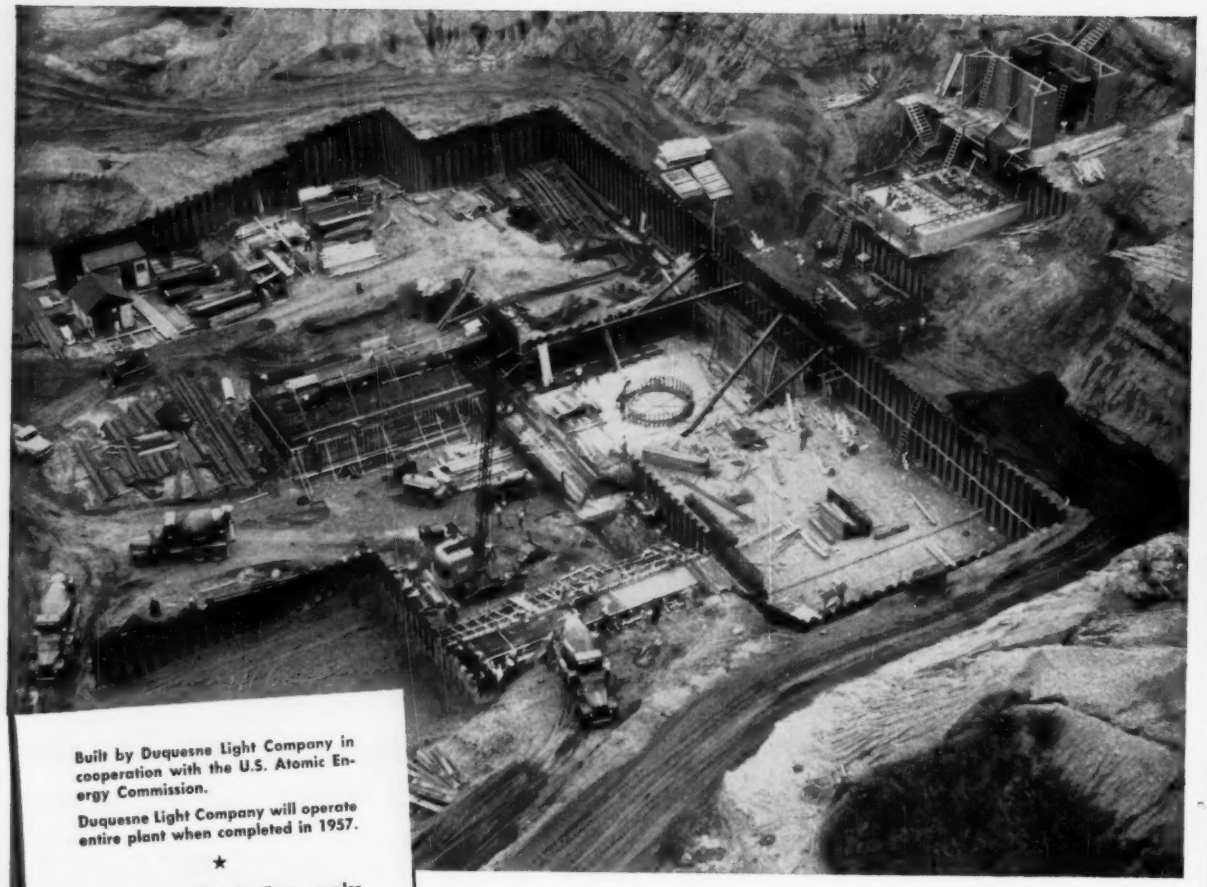
At Nation's First Full-Scale Atomic Energy

700 TONS OF USS STEEL

provide permanent retaining



Built by Duquesne Light Company in cooperation with the U.S. Atomic Energy Commission.

Duquesne Light Company will operate entire plant when completed in 1957.

★

Westinghouse Electric Corp., under contract with the Atomic Energy Commission, is building the reactor.

★

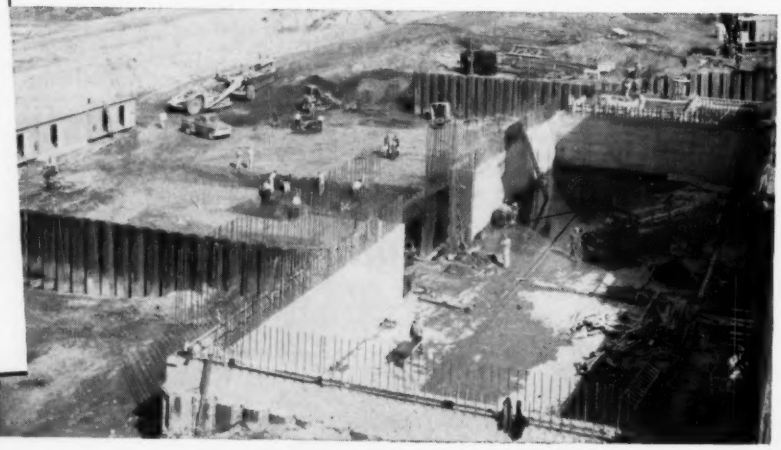
Burns and Roe, Inc. is the agent-constructor for Duquesne Light Co. Associates are J. Rich Steers, Inc., and Hatzel and Buehler, Inc.

★

Ferguson & Edmundson Company is sub-contractor for Excavation and Piling.

★

Stone and Webster Engineering Corporation is Architect-Engineer for Westinghouse.



Electric Power Plant—

SHEET PILING
wall for main structure of big project!

THE LARGE PICTURE at the left shows the foundation construction for the nation's first full-scale nuclear power plant.

Being built by Duquesne Light Company in co-operation with the Atomic Energy Commission, the huge project is located at Shippingport, Pa.—on the Ohio River about 25 miles below Pittsburgh.

This revolutionary plant, which will have a nuclear reactor producing at least 60,000-kw net electrical output, as well as a turbine-generator capable of 100,000-kw, will deliver electricity to Duquesne's customers in Allegheny and Beaver Counties.

Because the main structure will extend 75 ft. below grade, 23,896 lineal feet of USS sheet piling were driven to an average depth of 36 feet into the ground for the necessary retaining wall prior to the extensive excavating.

The approximately 700 tons of sheet piling not only served as the outside form for the pouring of the reinforced concrete walls, but were left in the ground permanently as a strong, durable steel skin for the concrete—*a double wall, so to speak.*

The application of USS Steel Sheet Piling at Shippingport is further proof that this versatile construction medium is the ideal solution to any problem involving the retention and control of earth or water. Forming a continuous wall, interlocking USS Sheet Piling offers easily installed construction that is strong, rugged and lasting.

For detailed information about this economical steel piling which is available in straight-web, arch-web, and Z-sections, contact the nearest office, or write to our Pittsburgh headquarters.

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USS

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UNITED STATES STEEL

NEWS OF ENGINEERS

Emerson C. Itschner, Major General, Army Corps of Engineers, will become Chief of Engineers, U. S. Army, effective October 1, succeeeding **Lt. Gen. Samuel D. Sturgis, Jr.,** who has applied for retirement. General Itschner, who is 53, is one of the youngest officers to be appointed Chief of the Army Engineers. He has had wide experience in the multiple operations of the Corps of Engineers in both peace and war. His experience includes three years in Washington, D.C., as chief of the Military Construction Operations Division, Office of the Chief of Engineers; one year as district engineer at Seattle, Wash.; engineer of the First Corps serving in Korea for fourteen months; and North Pacific division engineer, with headquarters in Portland. For the past two years he has been in Washington serving as Assistant Chief of Engineers for Civil Works. General Itschner's appointment was announced August 10, and is subject to Senate confirmation when Congress convenes.

Howard, Needles, Tammen & Bergendoff announce the removal of their New York offices from 55 Liberty Street to 99 Church Street, New York 7, N. Y.

Nathan W. Dougherty, dean of engineering at the University of Tennessee, has retired after more than 40 years of service. A graduate of the university, he returned there six years later as a member of the faculty. He has been dean of the College of Engineering since 1940. Dean Dougherty has been the recipient of many honors bestowed on him by engineering societies and professional groups, in recognition of his work as a teacher, administrator, and leader in the movement to improve engineering education. He was Director of ASCE from 1943 to 1945.

Dean Dougherty

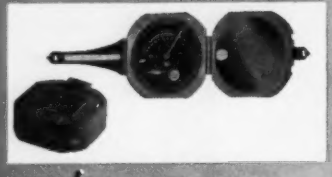
Claude H. Chorpening, Major General, Corps of Engineers, retired from active service on June 30, after more than 40 years of Army service. A retreat review and ceremonies including a 13-gun salute were held in his honor at Fort Belvoir, Va. General Chorpening's last assignment was to the U. S. Army Forces, Far East, where he served from April 1954 as Assistant Chief of Staff, G-4, at headquarters in Zama, Japan. For his services with the Korean Army while on this assignment, he was awarded the Order of Taeguk and the Ulchi Medal by the Republic of Korea.

Walter Schielke has been promoted to assistant to the vice-president, contracting, of U. S. Steel's American Bridge Division at Houston, Tex. Mr. Schielke joined American Bridge in 1936 as an assistant contracting engineer at the Birmingham office. In 1952 he was named contracting manager at Birmingham, holding this position until his recent promotion.

Joseph B. Diamond, professional engineer and attorney at law, announces the removal of his offices for the general practice of law to the Lincoln Building, 60 East 42nd Street, New York City.

(*Continued on page 30*)

BRUNTON*
pocket transit



for
civil engineers

- Ideal for preliminary and supplementary surveying
- May be used as compass, transit, level, plumb, alidade, clinometer
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- Shows direction to 1°...level, slope or grade within 1°.
- Used in hand or on tripod.
- Made to last a lifetime.

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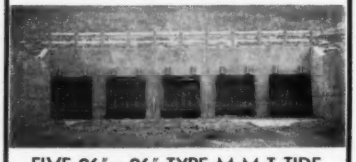
TIDE GATES



FIVE 96" x 96" TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

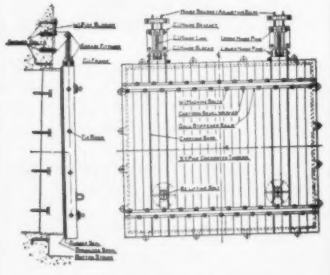
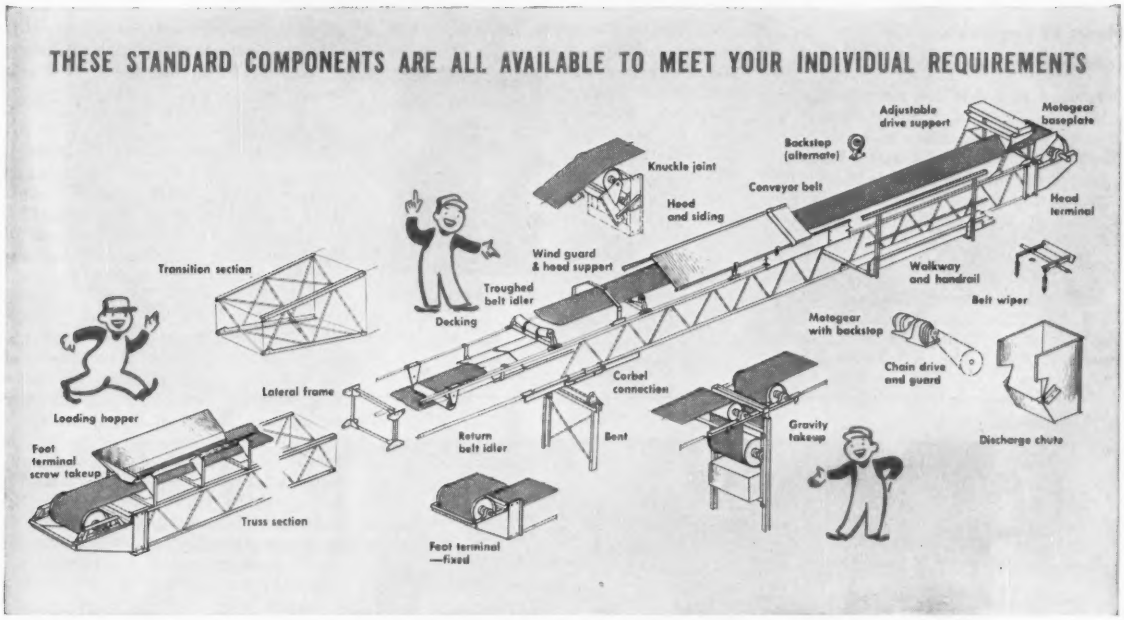


FIG. 9320 SHOWING TYPICAL CONSTRUCTION.

BULLETIN NO. 74—15 AVAILABLE UPON REQUEST.

BROWN & BROWN, INC.
LIMA, OHIO, U.S.A.



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Standard 18, 24, 30 and 36-inch widths need no special engineering

Here's an economical, standardized belt conveyor "package" . . . ready to meet the majority of belt conveyor needs and perform dependably for years and years. It combines standard Link-Belt products with sectional truss frames and steel supporting bents.

Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

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Your Link-Belt representative will help you select the best combination of PRE-BILT sectional belt conveyor components.

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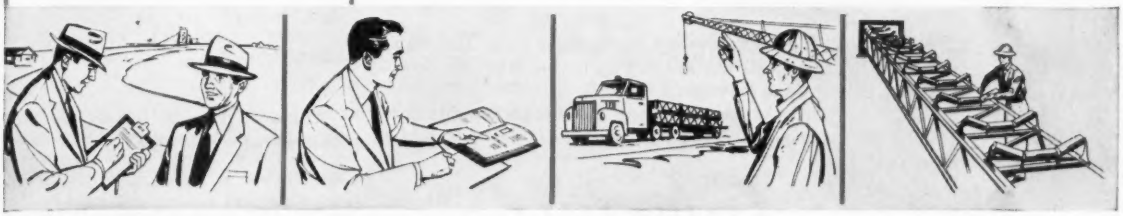

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quick delivery

PRE-BILT conveyors are built at nine strategic locations throughout the country and are shipped from the plant nearest you.

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Can be readily handled by your own erectors in most cases. Link-Belt can also furnish complete erection service and supervision.

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News of Engineers

(*Continued from page 28*)

Howard R. Gould was recently named a vice-president of Spencer, White & Prentis, Inc., with offices in New York, N. Y. Mr. Gould, formerly Midwest manager for the firm in Detroit, will be succeeded by **James C. Nelson,** formerly of Spencer, White & Prentis of Canada, Ltd., Toronto.

Earl Robert Bennett, Captain, CEC, U. S. Navy, was recently graduated from the Industrial College of the Armed Forces at Fort Lesley J. McNair, Wash.

Gustave G. Werner, Jr., has been elected a vice-president of the construction department of Merritt-Chapman & Scott Corp. of New York. Mr. Werner, who has served in the construction field on important projects throughout the world for more than 25 years, recently spent two years as construction manager for Morrison-Knudsen Co., Inc., on the French Moroccan air base project.

G. G. Werner, Jr.

George Spann has been promoted to the office of deputy chief engineer (design) of the New York City Board of Water Supply.

Robert T. Fey and **Harry W. Bridwell** have organized the firm of Bridwell-Fey Engineering Co., which will be located at 26 E. Gorham Street, Madison, Wis. Both partners are former employees of Mead and Hunt, Inc., Madison engineering firm.

L. Sterling Hedgpeth has been appointed district engineer for the Bureau of Public Roads in Liberia, where he will be responsible for developing and directing the highway project of the overall U. S. technical aid program carried on by the International Cooperation Administration. As the Bureau representative he is also consulting engineer to the Government of Liberia, on highways under an Export-Import Bank Loan Agreement, which provides credit to Liberia for financing its highway program. Mr. Hedgpeth was formerly chief of the Specifications and Materials Section, Construction Branch, of the Bureau's Washington office.

Robert S. Ayre, associate professor of civil engineering at Johns Hopkins University, has been named chairman of the department of civil engineering. Dr. Ayre has been a member of the faculty there since 1952. Formerly he was associate professor of mechanical engineering at Stanford University.

Richard L. Senior has been appointed construction manager of F. H. McGraw & Company, engineers and constructors of New York City. He will live in New Rochelle, N. Y., his hometown, to which he is returning after a 15-year absence. In his 44-year career Mr. Senior has supervised construction of almost $2 billion worth of building in all parts of the world. Prior to joining McGraw, he was operations manager for the Peter Kiewit Company on the AEC plant at Portsmouth, Ohio.

Richard L. Senior

Arthur C. Nauman, Colonel, Corps of Engineers, U. S. Army, has been assigned to the Office of the Chief of Engineers, Washington, D. C. Prior to this assignment he was district engineer for the Detroit District of the Corps of Engineers.

Richard D. Field was recently reassigned by the Corps of Engineers from chief, Engineering Division, Garrison District, to head up the $3,000,000

(*Continued on page 32*)

FIRST FOURTEEN YEARS OF LAKE MEAD
Horizontal Control, by R. M. Wilson
The triangulation during 1947-48 had several purposes: first, to recover triangulation stations set by Fairchild Aerial Surveys for control of the 1935 topographic maps made for the Soil Conservation Service (U. S. Department of Agriculture, 1935) and to test the precision of their coordinates; second, to tie in points of other previous surveys wherever possible, so that all these surveys might be coordinated on a common datum; and third, to establish convenient reference points for the 1948-49 hydrographic survey and to mark them permanently so that future surveys can be referred to the same points.
Altogether, 336 new reference points and triangulation stations were established, most of them just above the high-water mark of the reservoir. About 35 navigation lights or other objects were located by intersection, 15 stations of the Coast and Geodetic Survey were recovered and occupied, and 33 stations established in previous surveys were tied in. The position closures involved in all these ties indicate excellent work in the earlier triangulation in this area. Analysis discloses that the triangulation of 1935 is dependable and accurate, and entirely adequate for the purposes of this investigation, some of which required a higher order of accuracy than that required for use in making the maps under the 1935 contract.
GEOLOGICAL SURVEY CIRCULAR 246, 1954

14 years later

That's the way it always is with a topographic map. The map is needed yesterday. Costs are building up by the hour. No time to check or have it done over again.

It must be right to begin with: The flying, the control, the cartography. As in this case clients have learned . . . *you can depend on Fairchild.*

Call your nearest Fairchild representative on your next project requiring aerial surveying.

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MORE WATER...for your city, too

18% increased capacity with Cement Mortar Lining!

San Francisco arranged for Pipe Linings, Inc. to line 6 miles of the 44″ Calaveras water line *"in place"* on a bonus penalty basis.

Bonus for high capacity, penalty for low capacity.

The cleaned 44″ pipe, lined with cement mortar lining gave the City of San Francisco increased capacity... *increased capacity equivalent to adding a new 22″ pipe line.*

This represented a *capacity* increase of 13,300,000 gallons per day.

Here's how

Length Lined . . . 6 Miles
Contractor . . . Pipe Linings, Inc.
Capacity Increase . . . **18.1%**

Increased capacity was a prime consideration in reconditioning this line "in place."

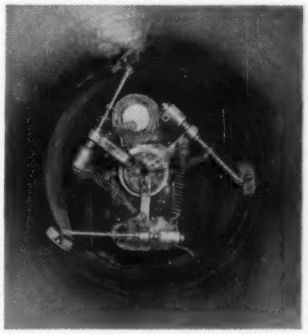
The terrain traversed by this line includes narrow canyon, creek crossings, short cuts over ridges, flatland and tunnel with pipe installed within. There were 298 horizontal and vertical bends ranging up to 30°.

Work on the contract began with the cleaning operations that required two passes with the hydraulic cleaning tool and were completed in 8 days. Lining operations were completed in 88 days elapsed time. Winching was required at five locations for lining aproximately 1250 feet of line where the grades were too steep for the lining machine to climb unaided. The average length of 44″ pipe which was machine lined in a normal working day was 500 feet.

Prior to reconditioning the line the "C" value was 115.8. The actual increase in flow was 13.3 mgd equal to 18.1 percent which is approximately equivalent to the capacity of a 22 inch diameter line.

The total cost for cleaning and lining 30,415 feet of line was $153,386. Cost of installing a new 22″ line (capacity gained) has been estimated at $672,760 . . . a saving of $419,374, or approximately 272% of the actual lining cost.

Cement mortar lining improves flow coefficients, reduces pumping and maintenance costs, prevents leakage, protects against corrosion. Let Pipe Linings, Inc. assist in your water capacity problems. Expert engineers are at your service.



Write for reprint of technical article covering the Calaveras job in detail. It appeared in one of the country's leading trade magazines. Write TODAY!

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J.S. STAEDTLER
GERMANY

News of Engineers

(*Continued from page 30*)

Passamaquoddy Tidal Power Survey recently authorized by Congress. For the past ten years he has been chief of Design and then chief of the Engineering Division for the Garrison Dam Project. His new address is 7 Standish Road, Stoneham 80, Mass.

Vincent B. Moore, chief of the Operations Division, Garrison District, Corps of Engineers, at Riverdale, N. D., has transferred to the Army Ballistics Missile Agency at Huntsville, Ala., where he is assistant chief of the Facilities Branch.

Walter E. Blessey, associate professor of civil engineering at Tulane University, has been promoted to professor of engineering. A member of the Tulane engineering faculty since 1942, he serves also as consultant to a number of construction firms in the New Orleans area.

De Forest A. Matteson has resigned as editor of ASCE Technical Publications to accept the position of technical editor of the Douglas Fir Plywood Association, Tacoma 2, Wash. Mr. Matteson is a graduate of Carnegie Institute of Technology and was associated with Bethlehem

De Forest Matteson

Paul A. Parisi

Steel Co. before coming to the ASCE headquarters staff four years ago. **Paul A. Parisi,** formerly associate editor, will succeed him as editor. Mr. Parisi is a graduate of Cooper Union and has been on the staff of ASCE Technical Publications for the past three years.

David W. Heiman, Brigadier General, Corps of Engineers, U. S. Army, has been named Acting Assistant Chief of Engineers for Military Supply and assigned to the office of the Chief Engineer in Washington, D. C. General Heiman has been assistant commandant of the Engineer School at Fort Belvoir, Va., since October 1955 and was recently promoted to Brigadier General (July issue, page 23).

William J. Kirchner has been promoted to chief engineer of the Heltzel Steel Form and Iron Company, Warren, Ohio. Mr. Kirchner has been with Heltzel for the past seven years, most recently as supervising engineer of the Bin Design Section.

Charile M. Moore, chief design engineer for a five-state U. S. Soil Conservation Service area, with headquarters in Fort Worth, Tex., has been named to a water resources fellowship at Harvard University. One of two engineers in the nation to be nominated by the Service for the honor, which will be shared by eight more from other federal agencies, Mr. Moore will study toward a master's degree. Mr. Moore has been with SCS since 1935 and heads the Engineering and Watershed Planning Unit. He is secretary-treasurer of the Fort Worth Branch of the Texas Section.

Linvil G. Rich has been appointed associate professor of civil engineering at Illinois Institute of Technology. Dr. Rich had been associate professor of sanitary engineering at Virginia Polytechnic Institute, where he received his doctorate in biochemistry in 1951.

George F. Flay, Jr., formerly chief engineer of the Drilled-In-Caisson Corp. of New York City, has been appointed chief engineer of the Stock Construction Corp., of the same city. Mr. Flay was recently awarded a "Certificate of Distinction" at the annual observance of Alumni Day at Polytechnic Institute of Brooklyn.

George I. Uitti was installed as the new president of the Michigan College of Mining and Technology Alumni Association at the Tech Reunion in Houghton, Mich., on August 9. He is president and structural engineer of Thomas J. Higgins Associates, Inc., Chicago, Ill. Mr. Uitti was graduated from the college in 1925 with B.S. and E.M. degrees and received his M.S. degree from Illinois Institute of Technology in 1939.

George I. Uitti

Rudolph E. Smyser, Colonel, Army Corps of Engineers, has been assigned as division engineer of the Ohio River Division, with headquarters at Cincinnati, Ohio. Prior to his new assignment, he was chief of the Construction Branch, J-4 Division, Headquarters, European Command, in Paris.

Benson L. Dutton has resigned as chairman of the Engineering School at the Tennessee Agricultural and Industrial State University, to accept the appointment of supervising engineer in the Bridge Design Section, Department of Streets, City of Philadelphia. Mr. Dutton established the engineering program now in existence at the college, and has also practiced as a consulting structural engineer in Nashville.

John E. Wiley has been appointed managing director of the Materials and Supplies Division of the American Road Builders' Association, Washington, D.C. In that capacity he will play a prominent part in stepping up the activities of the division. Mr. Wiley has been in Washington since 1950, serving the American Association of State Highway officials as assistant executive secretary and as editor of its official publication, *American Highways.*

John E. Wiley

Norman L. Liver has been appointed regional manager of the Atlanta, Ga., branch office of Intrusion-Prepakt, Inc., of Cleveland, Ohio. He has been associated with the firm since 1950, working on the development of the company's mixed-in-place pile method.

Herbert P. Orland has been named to take charge of publications for the Highway Research Board in Washington, D. C. For the past year, Mr. Orland has been associated with Scranton Publishing Co. as editor of its monthly magazines, and before that was with the Federation of Sewage and Industrial Wastes Associations.

Gerald J. Spolter announces the opening of consulting offices for the practice of civil and structural engineering at 1205 Lincoln Road, Miami Beach, Fla. Mr. Spolter has been with the Engineering Department of the City of Miami Beach for the past five years.

Edward P. Hamilton has been elected chairman of the board of John Wiley & Sons, Inc., New York City firm of technical publishers. Mr. Hamilton was formerly president of the firm.

Bernard M. Dornblatt, consulting engineer of New Orleans, La., has been elected second vice-president of the Consulting Engineers Council, the first national organization of independent consulting engineers. Mr. Dornblatt is a member of the firm of B. M. Dornblatt and Associates.

Torris Eide has been appointed a design consultant to the Board of Water Supply, New York City.

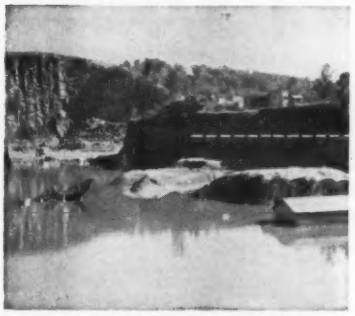
Alfred C. Drake has been named the general construction superintendent of the Electro Metallurgical Company, a division of the Union Carbide and Carbon Corp. Mr. Drake has been connected with the company since 1954, and was in charge of the construction of the Ashtabula titanium plant for it.

(*Continued on page 112*)

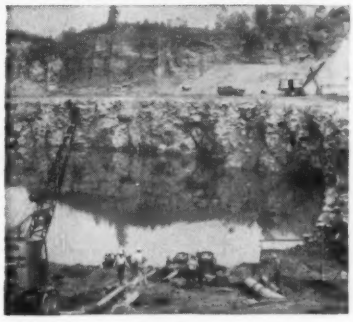
HOW TO HANDLE
WET JOBS

REMOVE 600 MILLION GALLONS FROM FLOODED QUARRY

Alpha Portland Cement Co. plant at Martins Creek, Pa.



HIT BY HURRICANE Diane, Martins Creek leaped its banks and flooded this quarry over 100 ft deep — shown by dotted line in photo.



WATER LOWERED 87 FT—14 ft to go — as Griffin pumps perform dependably and economically in one of the largest dewatering projects ever completed.

Griffin personnel and equipment were rushed, plans set and pumping started — all in 5 days. Quick Griffin service and reliable equipment helped Alpha resume production ahead of schedule.

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WELLPOINT CORP.
881 East 141st Street, New York 54, N. Y.
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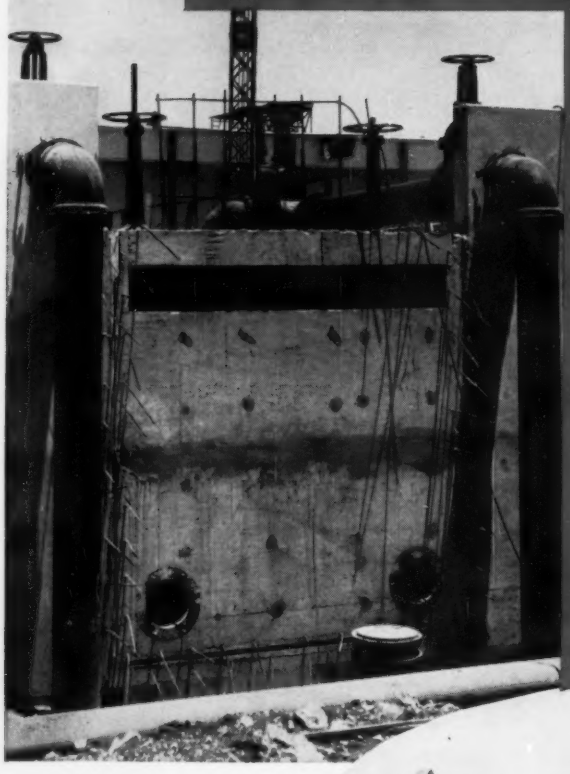
In Canada: Construction Equipment Co., Ltd.
Toronto Montreal Halifax

Used so many ways



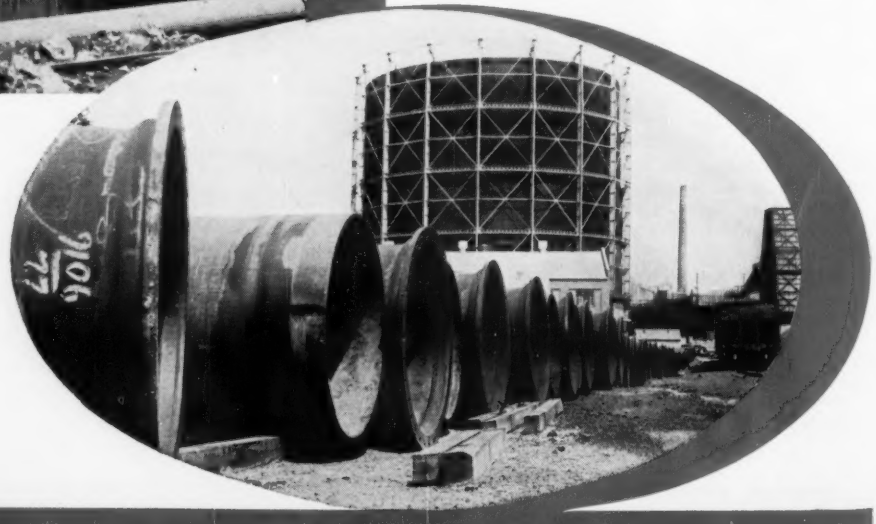
Never a doubt about cast iron pipe, no matter for what purpose you use it. And there are so many ways to put its rugged reliability to work for you. In *water* service, for fire protection and supply lines, feeder and distribution mains, purification plants. In *gas* service, mechanical joint cast iron pipe for distribution and feeder mains. In *sewerage* service, for force mains, outfalls and treatment plants. And in *industrial* service, uses too numerous to catalog. For information, write Cast Iron Pipe Research Association, Thomas F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Illinois.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

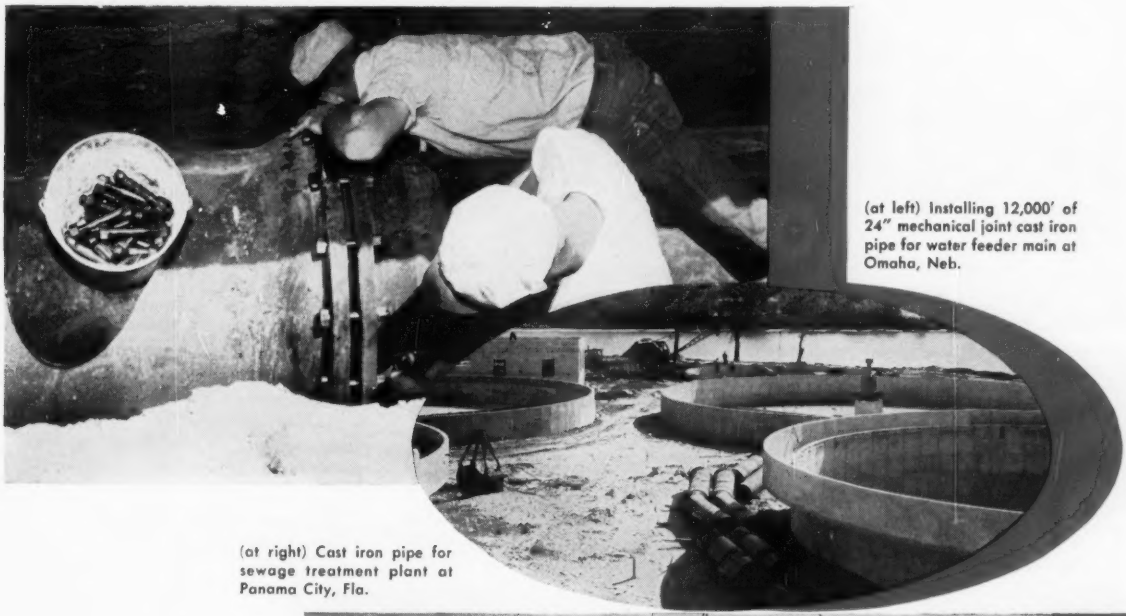
(above) Installation of mechanical joint and flanged cast iron pipe carrying salt water for Oceanarium, "Marineland of The Pacific" at Portuguese Bend, Calif.

(at right) 48" mechanical joint cast iron pipe for gas main at Indianapolis, Ind.



CAST IRON PIPE

—always with confidence



(at left) Installing 12,000' of 24" mechanical joint cast iron pipe for water feeder main at Omaha, Neb.

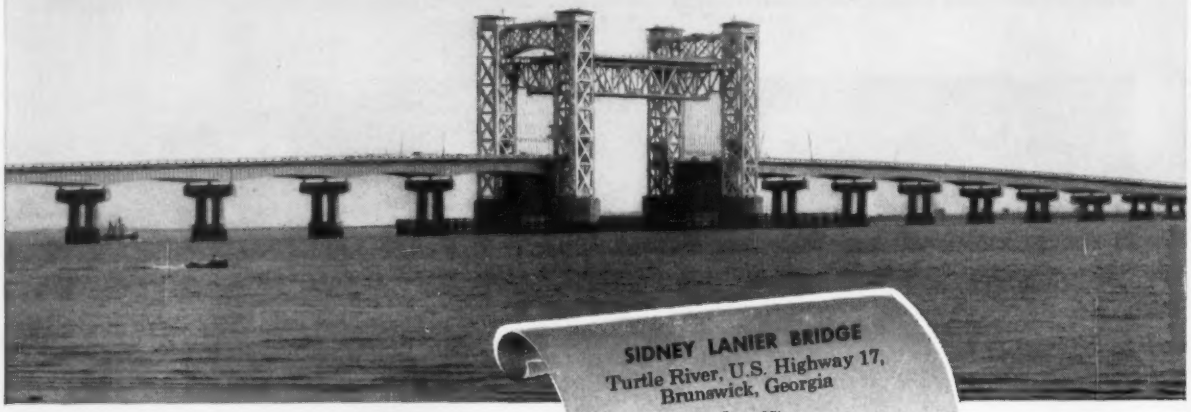
(at right) Cast iron pipe for sewage treatment plant at Panama City, Fla.

36" mechanical joint cast iron pipe for outfall sewer line at Los Angeles, Calif.

SERVES FOR CENTURIES...

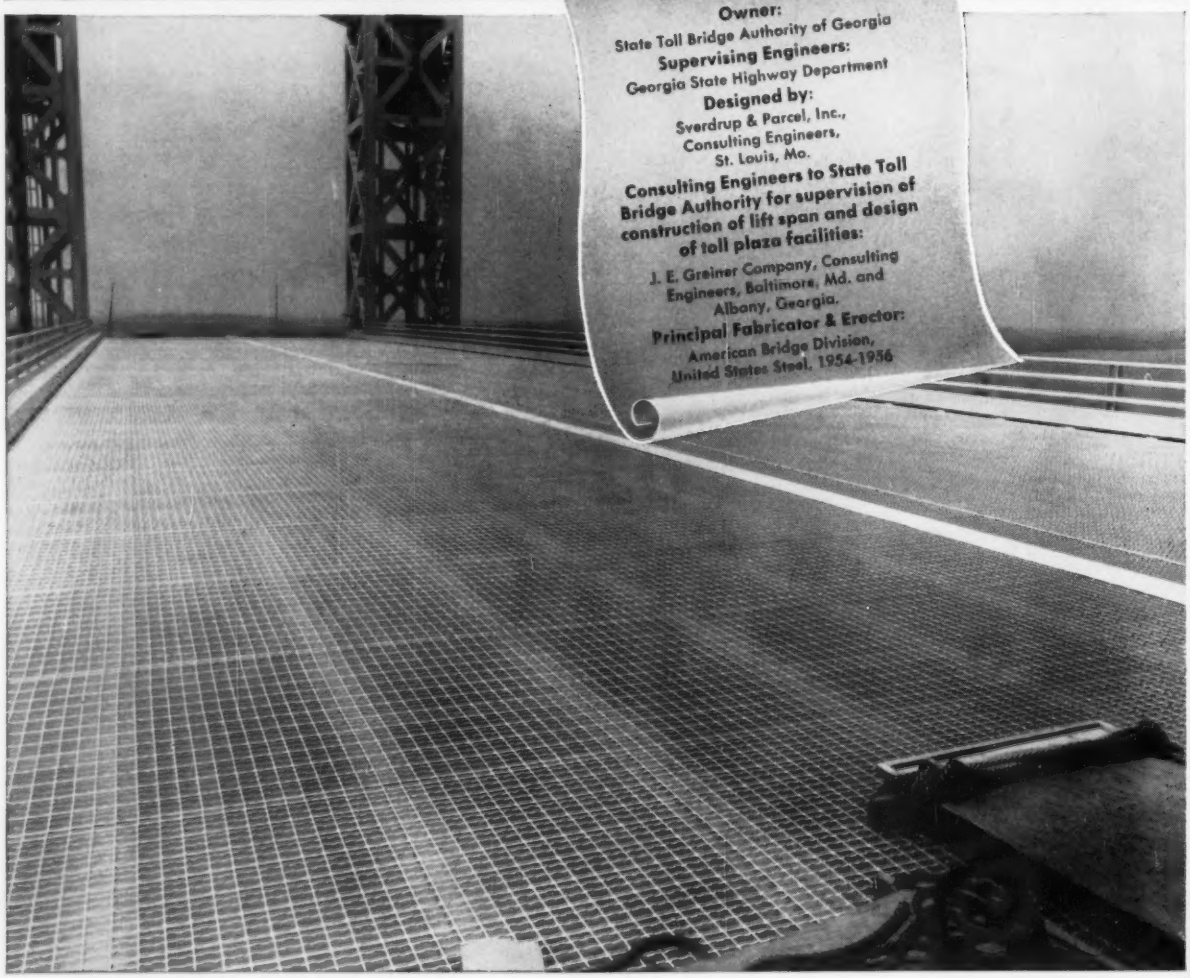
On this 295′ vertical lift span

I-BEAM-LOK saves



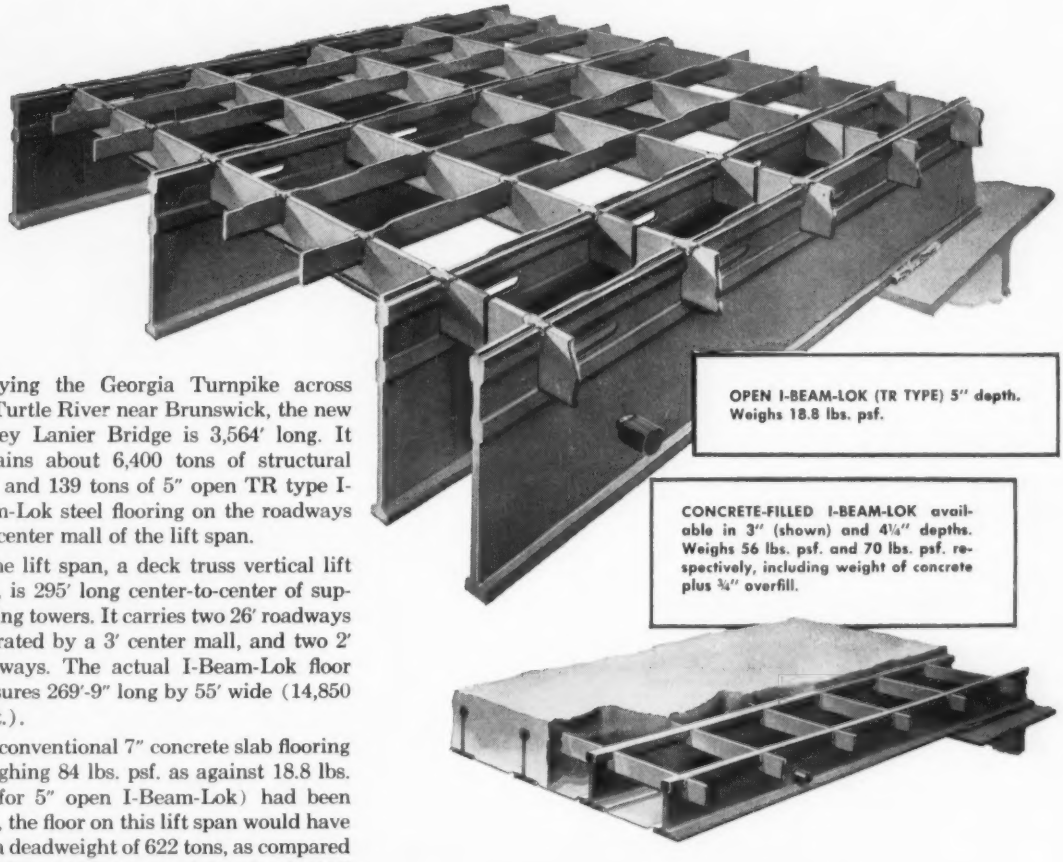
SIDNEY LANIER BRIDGE
Turtle River, U.S. Highway 17,
Brunswick, Georgia

Owner:
State Toll Bridge Authority of Georgia
Supervising Engineers:
Georgia State Highway Department
Designed by:
Sverdrup & Parcel, Inc.,
Consulting Engineers,
St. Louis, Mo.
Consulting Engineers to State Toll Bridge Authority for supervision of construction of lift span and design of toll plaza facilities:
J. E. Greiner Company, Consulting Engineers, Baltimore, Md. and Albany, Georgia.
Principal Fabricator & Erector:
American Bridge Division,
United States Steel, 1954-1956



USS AMBRIDGE

483 tons flooring deadweight



OPEN I-BEAM-LOK (TR TYPE) 5" depth. Weighs 18.8 lbs. psf.

CONCRETE-FILLED I-BEAM-LOK available in 3" (shown) and 4¼" depths. Weighs 56 lbs. psf. and 70 lbs. psf. respectively, including weight of concrete plus ¾" overfill.

Carrying the Georgia Turnpike across the Turtle River near Brunswick, the new Sidney Lanier Bridge is 3,564′ long. It contains about 6,400 tons of structural steel and 139 tons of 5" open TR type I-Beam-Lok steel flooring on the roadways and center mall of the lift span.

The lift span, a deck truss vertical lift type, is 295′ long center-to-center of supporting towers. It carries two 26′ roadways separated by a 3′ center mall, and two 2′ walkways. The actual I-Beam-Lok floor measures 269′-9" long by 55′ wide (14,850 sq. ft.).

If conventional 7" concrete slab flooring (weighing 84 lbs. psf. as against 18.8 lbs. psf. for 5" open I-Beam-Lok) had been used, the floor on this lift span would have had a deadweight of 622 tons, as compared with the actual floor weight of only 139 tons with open I-Beam-Lok . . . *a clear saving of 483 tons!*

Delivered in completely fabricated units ready for erection, USS AmBridge I-Beam-Lok is the modern bridge flooring for today's heavy traffic. It combines light weight and ensuing reduced costs of supporting members with roadway rigidity, ease of erection, a smooth, hard surface and low maintenance costs.

I-Beam-Lok bridge flooring is available in both open and concrete-filled types. Our new booklet gives complete information on both types of USS AmBridge I-BEAM-LOK. For your copy, write to American Bridge or contact the nearest sales office.

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UNITED STATES STEEL

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Pre-Stressed, Pre-cast Concrete Units Solve Labor Costs

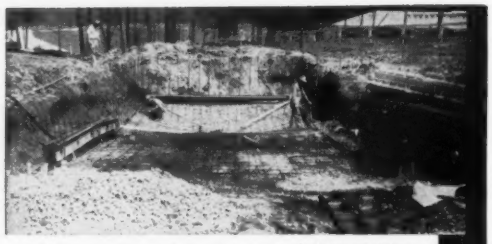
The NATIONAL POOL package includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and complete filter system. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed pre-cast interlocking concrete wall sections fit into each other and solves cost problem. Pool walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets.

PRICES START AT $1,300.00 for 16′ x 32′ PRIVATE POOL COMPLETE WITH FILTER SYSTEM, PUMP, MOTOR AND FITTINGS. PUBLIC POOL PACKAGE PRICE STARTS AT $3464.00 for 20 x 40 POOL. PUBLIC POOL PACKAGES ARE AVAILABLE FOR OLYMPIC SIZE POOLS.

Superior equipment—filter systems—underwater lights—ladders—vacuum cleaners—diving boards—heaters—paint for pool construction. Write for catalogue and price list.

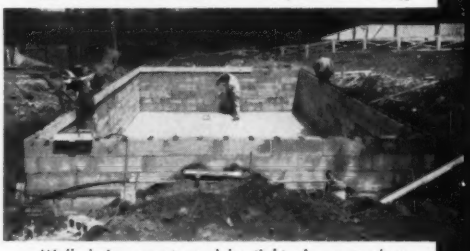
Refer to the May issue of Coronet magazine on NATIONAL POOLS

(Valuable dealer-franchises available to qualified builders, write today for full information)



Excavation for pool showing steel reinforcement for floor and inside pool walls.

Vertical pre-stressing steel rods are ready for interlocking precast concrete units to be placed over them. No heavy construction equipment needed. All work can be done with inexperienced labor.



Walls being pre-stressed by tightening nuts above steel bearing plates, after concrete mixture has been poured inside pre-cast concrete sections. Prevents cracking. No forms needed.

The finished pool has been coated inside with snow white marble-lite. Tile border and coping around top.
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pool equipment co.
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do you know that

A special highway issue is in the works? With the new national road program the current No. 1 engineering topic, the November number of CIVIL ENGINEERING will be devoted to highway planning and design.

A new ARBA salary survey is available? In bringing out its fourth survey of salaries for all grades of state highway engineers, the American Road Builders' Association notes that in the 20-month period since the last survey (September 1954) 29 states and the District of Columbia have increased salaries in practically all grades, and that there have been some increases in other states. Tables obtainable from the ARBA (World Center Building, Washington 6, D.C.) compare current salary ranges with a minimum salary schedule recommended by the AASHO in 1954.

The United States is to have an atomic-powered merchant ship? Government plans call for the $40,000,000 merchant vessel to be in operation within the next three years or less, depending on the type of reactor used. It will be an experimental model to see if such ships are economically feasible.

Drifting bottles are being used to chart pollution flow? Swimmers and fishermen in metropolitan waters are being asked to be on the alert for large bottles topped with bright flags, which are being set adrift in the harbor by the New York Health Department. The Department expects that the pattern of their drift toward beaches and shores will indicate sewage-flow patterns as affected by tides and currents.

Fort Randall Dam has been completed? After ten years under construction, this $203,000,000 Missouri River project was dedicated on August 11 in ceremonies held at Pickston, S.D. Primarily a flood control and power project, Fort Randall Dam has eight 40,000-kw generators. It was built by the Corps of Engineers.

The Big Thompson Project is in full operation? August 11 was also dedication day for the Bureau of Reclamation's recently completed Colorado–Big Thompson system. Hailed as one of the world's greatest water-diversion projects, the system carries water from the western slope of the Rockies to the eastern slope, via an elaborate system of power-houses, pumping plants, tunnels and canals. Through the 13-mile Alva B. Adams Tunnel under the Rockies will flow 550 cfs of supplemental irrigation water for 600,000 acres already under cultivation. Work on the $164,000,000 system began in 1937, and first water was delivered in 1948. A graphic description of this trans-mountain diversion, by Chief Engineer L. N. McClellan, M. ASCE, was printed in the June 1949 issue (page 27).

New production records are being set in steel and aluminum? In the eleven years since the end of World War II, the United States has produced more than a billion tons of steel. Previously eighteen years were required to achieve this tonnage. The June record was 9,758,000 tons, and the total for the first half of 1956 was 62,644,175 tons. Primary aluminum output, which came to 1,720,607,779 lb in the first six months, was also at a new high. Sources are the American Iron and Steel Institute and the Aluminum Association.

Radar is useful in surveying, too? With a new "radar ruler" developed by the Army Signal Corps' Engineering Laboratories at Fort Monmouth, N. J., the surveyor no longer has to depend on short-sighted optical equipment that is useless in bad weather. He can now measure off 50 miles without meticulous sighting, and readings are precise to within a few feet. Motorola, Inc., of Chicago, is making the system under Signal Corps contract.

Starting salaries for engineers continue to climb? Salaries received by 1956 graduates at Illinois Institute of Technology have reached an all-time high, according to Earl C. Kubicek, director of alumni relations and placement. Electrical engineers received the highest salaries, $461 a month compared with $416 in 1955. Other branches showing significant salary increases are chemical engineering, which rose from $365 in 1955 to $424, and civil engineering, which jumped from $380 to $434 in 1956.

Canada has an ambitious road program, too? In the next fiscal year Canada will spend $720,000,000 on road and street improvements, according to a survey of the Canadian Good Roads Association. Largest spender will be the Province of Ontario, which has a $181,000,000 budget. British Columbia expects to double its expenditures—from $37,000,000 in 1955 to $79,000,000 this year.

The October issue will feature the Pittsburgh Convention? From the many outstanding technical papers scheduled for the Convention, the October issue will include a symposium on the planning, design, and construction of the 60,000-kw atomic power station at Shippingport, Pa., scheduled for completion in 1957. For a preview of the technical feast in store see the Convention program on page 75 of this issue.

Drive-in Motor Lobby for

'Incor' Speeds Completion of 650-Car Garage

Dallas Adolphus Hotel

● Adolphus Hotel of Dallas is among the first to provide automobile drive-in facilities for guest registration. Hotel elevators lead directly to the Motor Lobby in the new 650-car garage, which covers 200 by 100 ft., with full basement, six floors and roof parking.

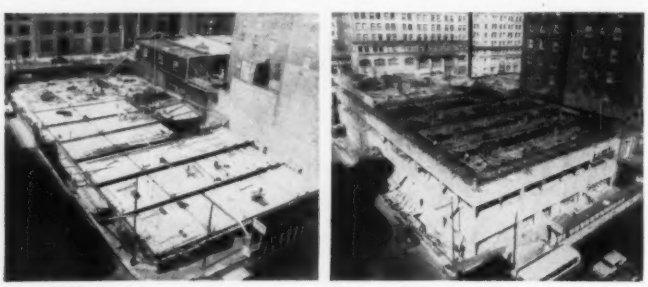
Good job planning and dependable 'Incor' high early strength made it possible to complete this durable, fire-safe structure seven months and two days after breaking ground, including time out for bad weather.

'Incor' was used in the frame as well as in basement walls, for 24-hour form removal. Result, top construction speed with fewer form sets. Same thing holds true for beam soffets and sides. Exterior street walls are concrete and glass, with lintel beams forming solid portion of walls.

Also used in 105,000 sq. ft. of precast, light-weight channels, 'Incor' made possible assembly-line production speed, with minimum forms and only a small stockpile of units in casting yard.

Big thing about 'Incor'* is profitable job speed. And along with dependable high early strength goes assured high ultimate strength as well—dual reason for insisting on America's FIRST high early strength Portland cement for lowest annual cost.

*Reg. U.S. Pat. Off.



(Left) View showing precast channels in place for first floor. (Right) photo shows manner in which floors were completed—excellent job organization and 'Incor' speeded construction of well-designed fire-safe, durable structure.

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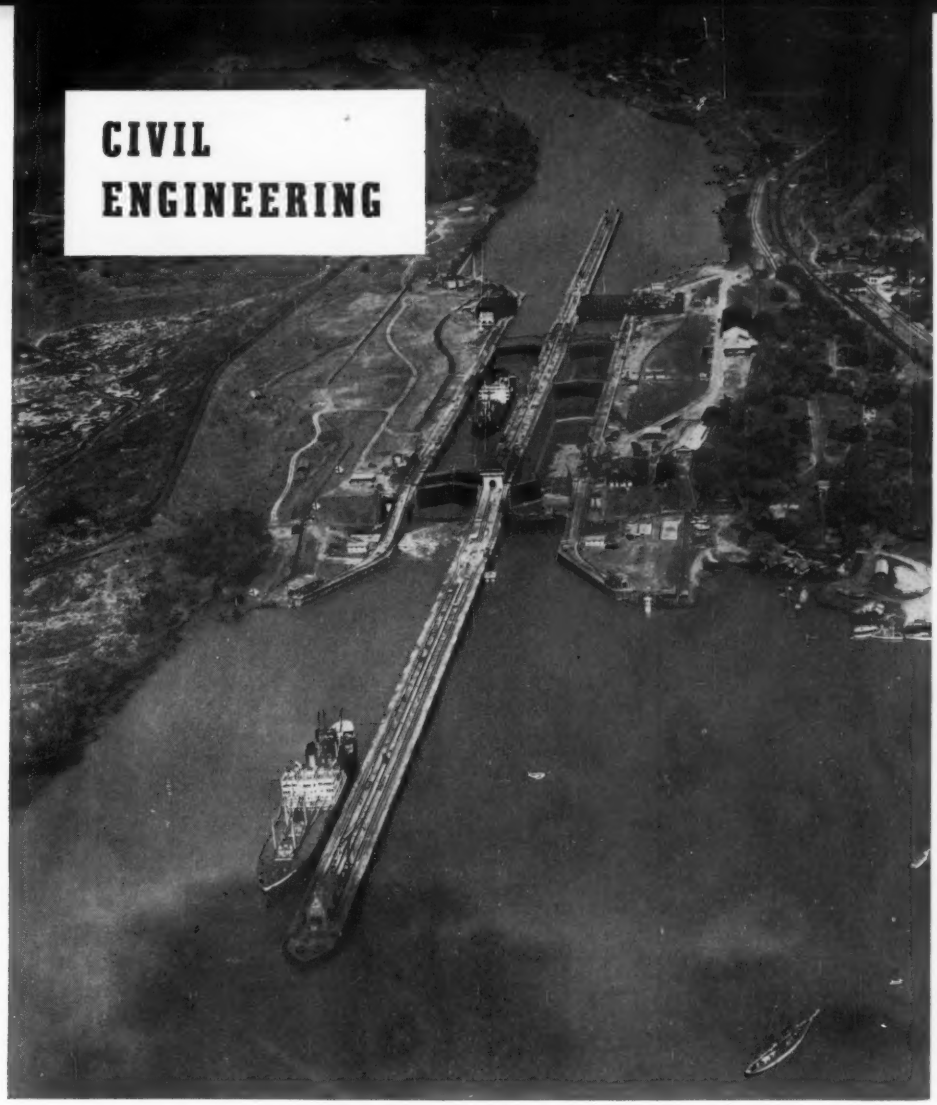


Increasing the capacity of the PANAMA CANAL

EDWARD M. BROWDER, Jr., M. ASCE,

Assistant Director, Engineering and Construction Bureau, The Panama Canal Company, Balboa Heights, C.Z.

Air view of Pedro Miguel Locks, Panama Canal, shows east chamber being overhauled while ships pass through west chamber. During critical months of January and February 1956, when overhaul was under way at Gatun Locks, traffic demand averaged 21.3 lockages a day, range being from 12 to 28 a day.

The Panama Canal, as designed and constructed under the direction of the Isthmian Canal Commission in 1907–1914, has been and is a model of engineering achievement. Its capacity, however, is limited. With the upsurge in postwar world trade, the capacity of the

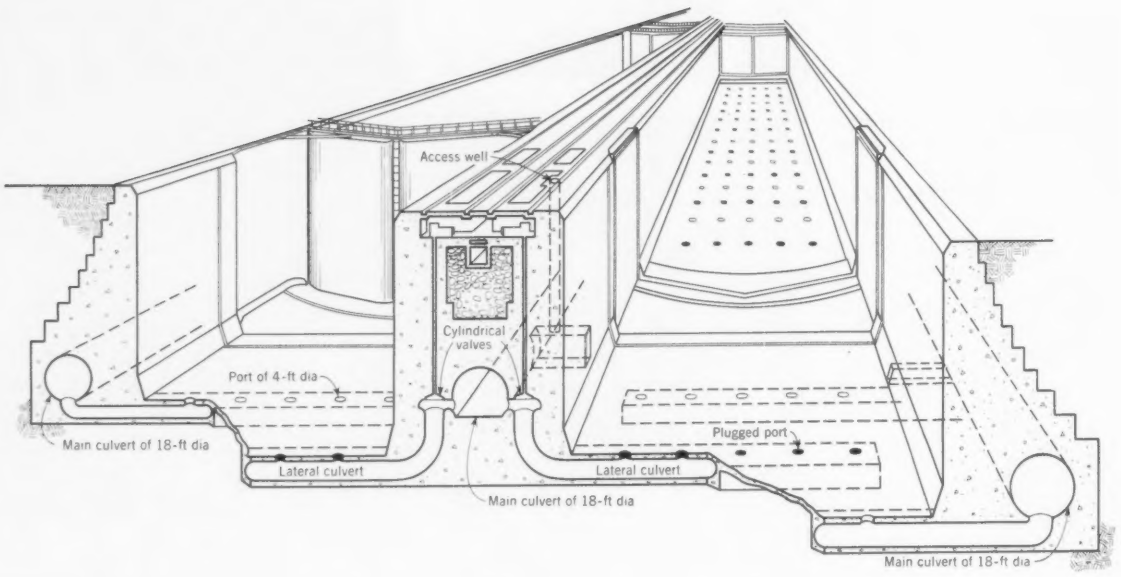


FIG. 1. Water is supplied to parallel lock chambers by three main culverts of 18-ft diameter running full length of each lock wall—one in center wall and one in each outside wall. Under new maintenance procedure, both lock chambers can be operated at once, using culverts in outside lock walls, while center-wall culvert and its valves are overhauled. This first phase of overhaul is illustrated, with center-wall culvert ports plugged in each lane—every other row of five outlets. In second phase of overhaul, one lock lane can be retired from use while other lane operates utilizing both side-wall and center-wall culverts. Former method required that one lock lane be retired from service during entire overhaul period, while other lane could be served by only one (outside) culvert. New method increases service during overhaul by approximately 25 percent.

present canal became a real problem, especially during periodic overhauls of lock gates and valves. The improvements and devices described here, which are now being provided, will increase the dependable capacity of the canal by approximately 25 percent during these critical periods of overhaul, at relatively small cost.

As is well known, the existing Panama Canal is a lock-type structure relying on the man-made Gatun Lake (nominal elevation 85 ft above sea level) for crossing the low continental divide. At each end of the waterway, locks are necessary for raising ships to the level of Gatun Lake and for lowering them on the other end.

The Atlantic locks consist of two parallel lanes of three-lift chambers, separating Gatun Lake from the sea-level section of the canal on the Caribbean end. The Pacific locks consist of twin single-lift chambers at Pedro Miguel at the south end of Gaillard Cut and Gatun Lake, and similar two-lift chambers at Miraflores. The latter locks connect Miraflores Lake (nominal elevation 54 ft above sea level) with the sea-level section of the canal on the Pacific end.

Under normal operations, as shown in Fig. 1, the parallel chambers are serviced by three main culverts of 18-ft diameter, which run the full length of each lock wall. Water is admitted or discharged by gravity by the operation of rising stem valves in the side and center walls at each end of each chamber. The center-wall culvert also has cylindrical valves at each lateral culvert (10 per chamber) to permit the one common center-wall culvert to serve either or both adjacent parallel chambers. Thus with both chambers in normal operation, ships may utilize adjacent chambers simultaneously for either "up-lockages" or "down-lockages." With the twin lanes in operation, serviced by the three culverts, the dependable capacity of the canal is approximately 54 lockages daily.

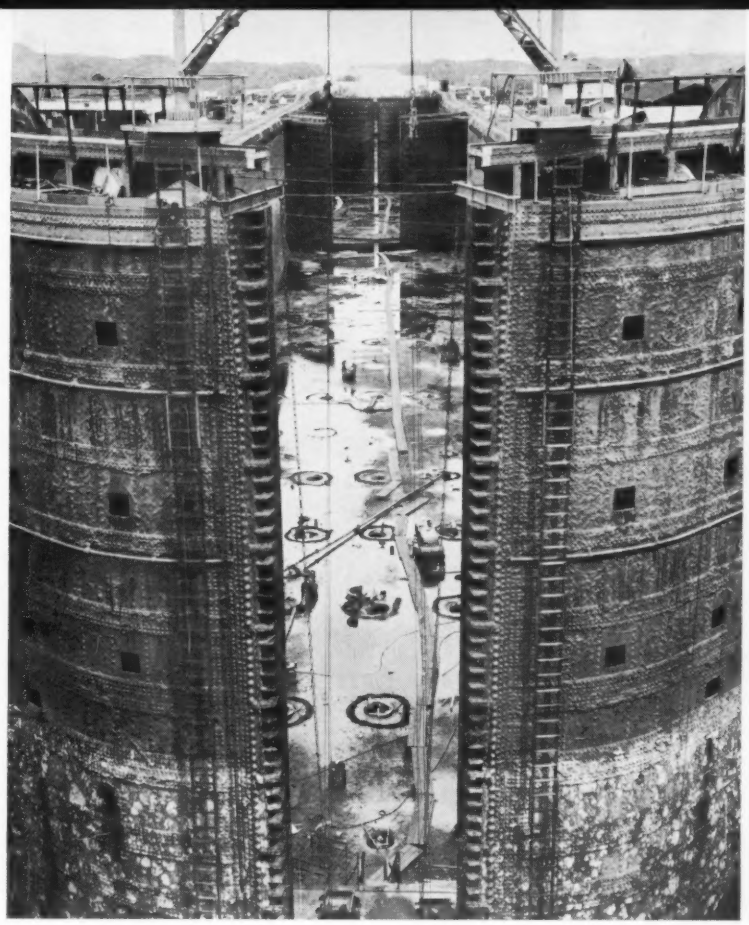
Previous overhaul procedures

It is necessary periodically to perform major repairs and maintenance work on those parts of the lock installations which are normally under water or otherwise inaccessible. It has been found that five years is the maximum period that can safely be allowed to elapse between major overhauls of under-water parts if serious failure of equipment due to wear and deterioration is to be avoided.

Periodic overhaul includes, to the extent necessary, the reconditioning, repair, or replacement of bearing plates, pintles, pintle bushings, sills, seals, latches, rising stem valves, guard valves, cylindrical valves, main cylinder glands, cathodic protection anodes, protective coatings, culvert entrance bulkheads, and other components.

Heretofore, during periods of overhaul, it has been customary to withdraw from service one entire lane of chambers, its adjacent side-wall culvert, and its adjacent center-wall culvert. Thus, the other lane of chambers, serviced only by its single side-wall culvert, had to accommodate all traffic through the canal during the entire period of overhaul. Since the one available lane of chambers was thus served by only one culvert instead of the normal two, the time required to perform a lockage was increased. This reduced the normal maximum number of lockages through the canal during overhaul from 54 daily to approximately 24.

Five years is considered maximum period that can safely elapse between major overhauls of Panama Canal locks. In view at right, looking north through Gates 21 and 22 at Gatun, culvert ports are seen being smoothed and shaped to fit plugs in 1956 overhaul program. Use of these plugs in new maintenance procedure greatly increases canal capacity during overhaul. In photo below is seen a typical cast-iron and structural-steel culvert plug, with rubber seal, weighing 1,400 lb. Diameter of ports is about 4 ft.



Devices for increasing capacity

The project now under way provides means for unwatering and overhauling the valves in the center-wall main culvert while both lanes are in service, each with its own side-wall main culvert in operation for emptying and filling the chambers. This may be called the first phase of the overhaul. During this phase the center-wall culvert and cylindrical valves can be overhauled with both chambers in service by the simple expedient of plugging the openings from the center-wall culvert in the floor of the lock chambers in both lanes. The availability of two lanes, each serviced by its adjacent side-wall culvert, provides a capacity of approximately 49 lockages per day.

The plugs, one of which is shown in a photograph, are of cast iron with structural steel cylindrical guides to assist in seating. They are fitted with rubber gaskets and weigh about 1,400 lb each. A total of 300 of these plugs is needed for Gatun Locks, where there are three lifts of parallel chambers, each with 10 lateral culverts of 5 ports each opening onto the center-wall culvert. A special barge, on which a truck crane can be mounted, is provided to assist the diver who places and removes these plugs under water.

Under the previous method of overhaul, the center-wall valves were reconditioned at the same time that the lock gates were reconditioned. Access was provided to the center-wall culvert through horizontal adits at each level. Under the new method, with the adjacent chambers both in use, these adits are not available. Hence new access shafts are required at each level of the center wall. The three vertical shafts, each 5 ft by $9\frac{1}{2}$ ft, have been completed at Gatun during the past few months and each is fitted with a removable elevator for quick installation, use, and subsequent removal during this stage of overhaul.

Additional pumping equipment is being provided for use in unwatering the center wall and in maintaining it against leakage during this stage of the overhaul. A sump was already available at the lower end of each center-wall main culvert for a small pump, but an additional sump, shaft, and pumps are being provided. Two deep-well pumps, each with a capacity of 15,000 gal per min (gpm), and one deep-well pump with a 4,400-gpm capacity, are being provided. These may be moved from the Atlantic locks to the Pacific locks as required.

In addition, an improved system of ventilation is required in the center-wall main culvert since the side openings to the cylindrical valves are closed when both chambers are in operation. The new ventilation system will consist of four blowers of 24,000-cu ft per min capacity each, to force fresh air into the culvert through the inspection shaft at one end; the air then escapes through the access shaft at the other end.

After the center-wall culvert valves have been overhauled with both lanes in service, as has been described, a single lane of chambers is retired from service in the second phase of the overhaul work. In this second phase, while one lane of chambers is undergoing overhaul of miter-gate leaves and side-wall valves, the other lane is in service utilizing both center-wall and side-wall culverts for water supply. This is made possible simply by closing all the center-wall cylindrical valves leading from the center-wall main culvert to the lane being

overhauled. With this procedure, the chambers of the lane in service can be emptied and filled in about half the time required with the former overhaul method, where only the side-wall culvert could be utilized. During this second phase of the overhaul work, the dependable capacity of the canal will be approximately 30 lockages a day, instead of 24 under the previous method. This is an increase of about 25 percent.

Stability of center wall studied

Some apprehension had been felt for the stability of the concrete gravity center-wall under this second phase of the revised overhaul procedure, wherein the main center-wall culvert is filled with water and an unbalanced side pressure is exerted by the single full lock chamber. The original design of the lock walls correctly calculated that under these conditions a small amount of tension would occur near the inner surface of the culvert. (See "Design of Lock Walls and Valves," L. D. Cornish, Transactions of International Engineering Congress, 1915, Vol. 2, Paper No. 16.) Accordingly reinforcing steel was provided at this point, although it was not then intended that the middle culvert would be filled when one of the lock chambers was dry.

A thorough reanalysis of the critical section of the center wall was again made before the start of the project. It was found that, while tension would occur under the assumed loading conditions, the reinforcing steel originally provided would be only nominally stressed. Operations under these conditions for three months, January through March 1956, produced no untoward effects.

Effects on canal capacity

The capacity of the canal under normal operating conditions, with two lanes in service and three culverts in operation is approximately 54 lockages a day. This capacity is unchanged by the present project. However, during the periodic overhauls which must be under way for an average of approximately 10 percent of the time, the capacity formerly was about 24 lockages a day. Under the new arrangement, over the greater part of the overhaul period, the capacity has been increased to at least 30 lockages a day, and to 49 lockages a day for the remaining part of the overhaul period. This estimate of increased lockages during overhaul has been confirmed in the recent overhaul period, January through March 1956, when a maximum of 28 lockages were handled with slightly less than full crews in less than a 24-hour period.

Some estimates of the increased capacity have been as high as 34 lockages a day, but at least a part of this increase is due to improved ship handling methods. These ship handling improvements have been effected by: (1) more dextrous and skillful accomplishment of relay lockages, and (2) an additional tug to assist ships at the start of a lockage. The relay lockage is carried out by using two sets of towing locomotives to handle a series of continuous lockages in the same direction in the same lane. The first set of locomotives brings the vessel from sea level (on an "up-lockage") into the first or second chamber and then returns to sea level while the second set of locomotives completes the lockage.

Completion of the project here described will bring the dependable capacity of the canal during the critical overhaul period to a comfortable margin above actual present requirements. During the period from July 1, 1954, to June 30, 1955, the traffic demand averaged 20.3 lockages a day. For the critical months of January and February 1956, when an overhaul was under way at Gatun Locks, the traffic averaged 20.6 and 21.9 lockages a day respectively, with a range during this two-month period of from 12 to 28 lockages a day.

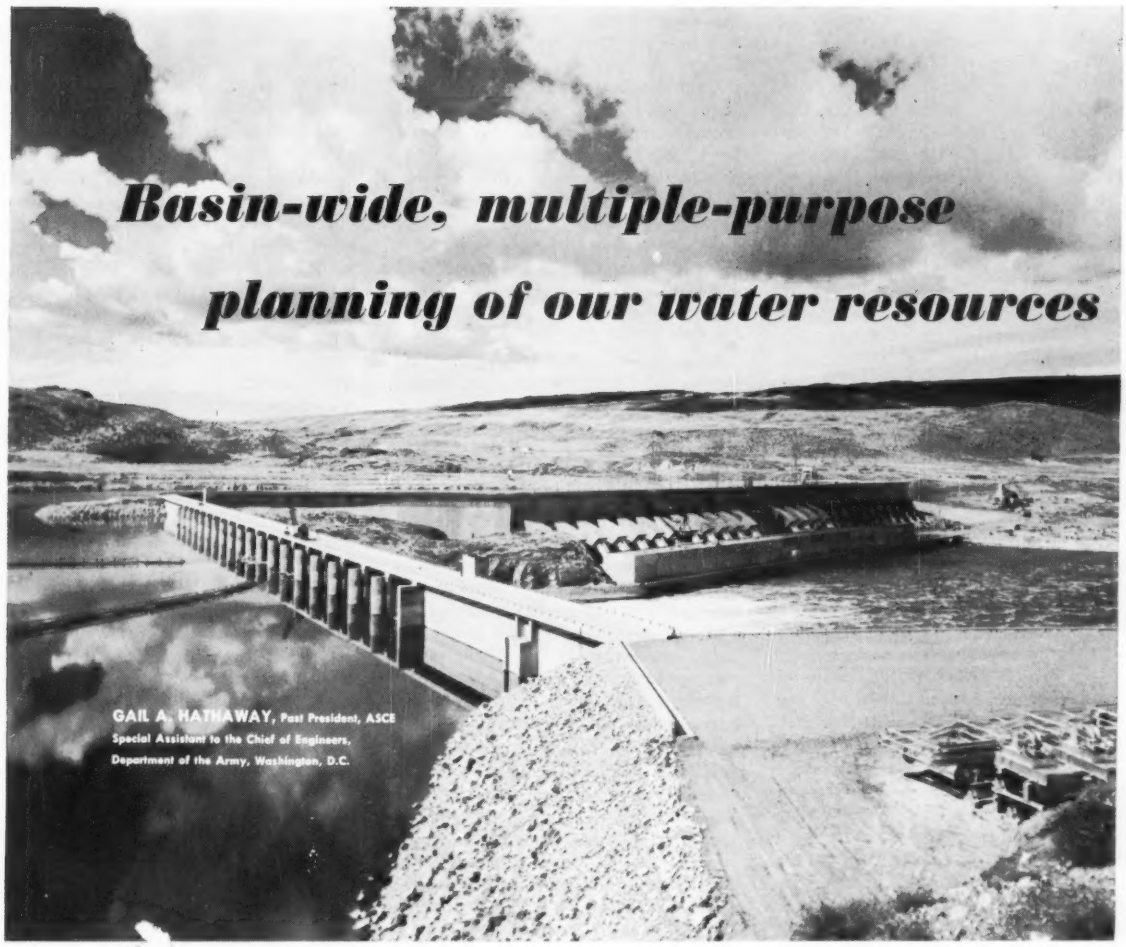
The long-range problem of greatly increasing the capacity of the Panama Canal, as well as that of increasing its security in the Atomic Age has been thoroughly discussed in ASCE journals (*Transactions*, Vol. 114, 1949, p. 607; and CIVIL ENGINEERING, Vol. 24, 1954, p. 58).

The project of improving maintenance procedures as here discussed is now about two-thirds complete for all locks. Its cost is estimated to be about $780,000. This includes the cost of the necessary alterations to the locks and the purchase and testing of the devices and equipment installed.

The work thus far has been accomplished by the Panama Canal Company under the overall supervision of Maj. Gen. J. S. Seybold, Corps of Engineers, Retired, Governor–President; Col. H. W. Schull, Jr., C. E. Lieutenant Governor–Vice President; and Col. Hugh M. Arnold, C. E., Engineering and Construction Director. General Seybold's term of office as Governor-President expired in May 1956. The project will be completed under the overall supervision of the present Governor-President, Maj. Gen. W. E. Potter, Corps of Engineers. (All are Members of ASCE.)

To increase the capacity of the canal 25 percent during maintenance will ultimately cost an estimated $780,000. Compared to the added security and added revenues this is a relatively small cost. In photo, U.S.S. *New Jersey* passes through Pedro Miguel Locks.

Basin-wide, multiple-purpose planning of our water resources



GAIL A. HATHAWAY, Past President, ASCE
Special Assistant to the Chief of Engineers,
Department of the Army, Washington, D.C.

Chief Joseph Dam has one of the world's longest powerhouses—at right center. Spillway and reservoir are at left. Powerhouse will eventually house 27 turbines of 100,000 hp each and 27 generators of 64,000-kw rated capacity each.

A series of great floods on the main stem of the Mississippi River and tributaries following the turn of the century created widespread interest in the question of storage reservoirs and flood control. Because of the growth and development of the region, damage had been greatly intensified. The *Transactions* of the ASCE of that period contain numerous papers on such subjects as the value of forest growth in preventing floods, the relative merits of storage reservoirs, retarding basins, levees, cutoffs, and channel enlargements.

At the annual meeting of the Society in January 1916, more than forty years ago, a special Committee on Floods and Flood Prevention submitted a report on the subject. (ASCE *Transactions*, Vol. 81, December 1917, pp. 1218-1229). The Committee's report, a minority report, and some sixteen discussions occupy almost one hundred pages of the December 1917 *Transactions*. In that section of the Committee's report concerned with reservoirs, it was concluded that storage reservoirs and detention basins located at the headwaters of streams, could be successfully employed to reduce flood heights, but the possibility of efficiently utilizing a reservoir for more than one purpose was questioned.

On the basis of subsequent developments, the most important and far-reaching viewpoint included in the many discussions of the Committee's report was that of Farley Gannett, M. ASCE, Consulting Engineer of Harrisburg, Pa. Under the heading of "Multiple Use of Reservoirs," Mr. Gannett stated that he believed, with General Chittenden, that reservoirs could be utilized satisfactorily for flood control and other purposes as well. He cited two large storage projects that he had designed for multiple-purpose use and, in summary, wrote this prophetic statement:

"For these reasons the writer believes that real widespread flood control through reservoir construction and storage will be brought about by the construction of reservoirs principally for other utilization purposes, such as water supply, water power, industrial use, navigation, irrigation, and for esthetic purposes, such as park lakes, improvement, sanitation, etc."

Mr. Gannett's position was supported by several others in the discussion of the Committee's report, so that almost forty years ago engineers of outstanding reputation in the field of water resource development were convinced of the

feasibility of operating reservoirs to serve more than one purpose.

The problems of water resource development have long been under study by the Corps of Engineers. The initiation of action leading toward the application of the multiple-purpose concept of basin-wide development of our water resources was made possible when Congress, in the River and Harbor Act of 1927, authorized the comprehensive river basin studies known as the "308" surveys. The stated purpose of these surveys was to formulate general plans for improving our rivers for navigation, power development, flood control and irrigation, thus for the first time incorporating the multiple-purpose idea into basin-wide planning. Undoubtedly one of the greatest contributions of these reports was to clearly demonstrate the value of the multiple-purpose concept.

Not until the establishment by Congress on May 18, 1933, of the Tennessee Valley Authority was there an opportunity for comprehensive development of an entire watershed. There were previous multiple-purpose projects such as the Muscle Shoals Development on the Tennessee River, authorized by the National Defense Act of 1916 to provide for improvements to navigation, development of water power, and production of nitrates and fertilizers; the Boulder Canyon Project Act, passed by Congress in December 1928 for irrigation, development of water power and flood control; the Tygart multiple-use reservoir on headwaters of the Ohio for flood control, water supply and future power development; and the Sacandago Project in New York State for flood control, power, and low-water flow regulation, but none provided for basin-wide development.

Advantages in multi-purpose planning

There are numerous advantages inherent in multiple-purpose planning and development. One is economy, because in most instances it is more economical to combine several functions or water uses in a single project than to build several single-use projects. Another advantage is growing in importance each year, that is, the conservation of project sites. Most of the good locations for dams have been preempted. It is therefore essential that the potentialities of the remaining sites be utilized as fully as is practicable. Multiple-purpose construction may permit development of water uses that could not be justified individually and, perhaps most important, multiple-purpose construction provides for future flexibility in the use of water.

Adequate provision for future flexibility in uses of water is of transcending importance because increasing demands will, in many cases, dictate changes in priority of use. There are already several outstanding cases of record where changes in the use of water have been brought about for various reasons. Since the economy of this nation is dynamic and ever changing, the development of a water policy, particularly in connection with the priority of water uses, should proceed on a realistic basis that will accommodate the trends of a well-balanced and progressive economy.

No static policy possible

Much has been said about the establishment of a national policy for the development of our water resources, and this might indicate to the uninformed that the nation has no water policy. Quite to the contrary, we do have a water policy that has been developing over the years as expressed in our existing laws pertaining to navigation, flood control, reclamation, and watershed development. It is not yet the best one that could be achieved, but we are making progress. I doubt if we ever could achieve a national water policy that would remain static and unchanged for all time. We should continue to develop our existing policy on a step-by-step basis with continual modification to meet our changing needs.

Any revision of our existing policy should emphasize the concept of comprehensive basin-wide (or in some cases regional) multiple-purpose planning and development, and all state and federal agencies having responsibilities and interests in water and related land resources development should participate in this basin-wide planning.

One important phase of our water resources policy required for sound basin-wide planning is a comprehensive program of basic data collection, involving substantial expansion and acceleration of current programs. Concurrently, there should be a continuing nation-wide inventory, by river basins, of water resources development needs. Many of the present needs or problems probably did not exist or were not apparent 25 years ago so that we may expect that additional problems, not of major significance now, may be extremely important in another 25 years. Accordingly, our analysis of development needs, upon which program formulation is largely dependent, must contain strong elements of imagination and foresight.

Program should be realistic

In connection with the problem of program formulation, the major objective should be to provide the fullest justifiable development of our water resources based on estimates of costs and benefits that are realistic, having due regard for future economic development and expansion.

The Corps of Engineers has traditionally supported the principle that federal water resources projects should return benefits in excess of their costs. In the case of allocation of costs for multiple-use projects, the Corps distributes project costs equitably among the purposes served, so that all project functions share in the savings resulting from multiple-use development. In general, this objective is obtained by providing that costs allocated to any function do not exceed its benefits; by providing that each function is carrying at least its separable cost; and, within these maximum and minimum limits, by providing for a proportionate sharing of savings resulting from multiple-use development. This method permits a sharing of savings among all project functions and avoids the subsidizing of any one function at the expense of the others.

With regard to economic evaluation, the Chief of Engineers has led the way in accepting and applying the principles of the Federal Inter-Agency River Basin Committee's report on "Economic Analysis of River Basin Projects," known as the "Green Book," and the Bureau of the Budget's Circular No. A-47, which was designed to set forth the standards and procedures to be used by the Executive Office of the President in reviewing proposed water resources project reports and budget estimates for initiating the construction of such projects.

Local participation important

The importance of state and local participation in the planning and development of our water resources program cannot be overemphasized. States and local interests should play a more active role. The report of the Presidential Advisory Committee recommends measures to meet this need.

Closely related to state and local participation is the subject of cost sharing. It is proper that the local interests should share in the cost of projects which benefit them, and in some proportion to the extent and character of local benefits. Existing legislation, however, differs regarding the degree of cost sharing, and there are widely varying requirements for cost sharing in the fields of navigation, flood control, reclamation, water supply, and watershed protection. Greater consistency in the degree of cost sharing in these various fields is unquestionably desirable, but it should be recognized that some variation in the degree of cost sharing required for projects of various magnitudes and various kinds of impact, is proper.

Water supply, a growing problem

Consideration of an assured, adequate supply of water for domestic and industrial use in our communities must be given a considerable degree of preference in future water resources development programs. The Chief of Engineers, Lt. Gen. S. D. Sturgis, Jr., M. ASCE, in his public appearances, has repeatedly attempted to warn the nation of the increasingly critical problem of having enough water available when and where we need it.

Underground supplies cannot be depended upon to solve this problem although scientific management of areas of undeveloped ground-water storage may possibly double the existing withdrawal from ground-water reservoirs. Good soil conservation practice and proper forest and grass cover may, in some areas, increase the availability of water, particularly its distribution throughout the year. Recirculation, pollution abatement, reclamation of used water, and better use of existing supplies will help, but in large part the fulfillment of the ever-increasing demands must depend upon conservation of surface water by reservoir storage.

The Federal Government is already rendering important cooperative services in the field of water supply. However, as a general rule these services are primarily for existing interests, to take care of existing needs. Furthermore, the services now rendered are generally incidental to some other primary objective or objectives of the reservoirs. The reservoirs of the future should—not incidentally, but through deliberate scientific planning and design—play increasing roles in the conservation of an adequate water supply for the future.

New legislation needed

New legislation will be required to give those agencies dealing with water resources development appropriate authority to include water supply as a specific function in the planning, construction, and operation of their projects. The Chief of Engineers believes that water supply legislation along the following lines is desirable:

1. Announce a policy recognizing the primary responsibility of states and local interests for developing water supply, but also recognizing that the Federal Government should cooperate with them in developing such supplies.
2. Make specific provision for the consideration of water supply in studies and reports for flood control, navigation and multiple-purpose developments, and for consultation with the U. S. Public Health Service and with affected states.
3. Grant general authority to modify existing and authorized projects to provide water supply except where a major change in purpose and scope would be involved. Major changes should continue to require Congressional authorization.
4. Require costs to be allocated so that all authorized purposes share equitably in the benefits of multiple-purpose development.
5. Allow repayment by water users within the economic life of the project, not exceeding 50 years, at government rates of interest.
6. Authorize the inclusion of provisions for future water supply in projects, with reasonable limitations on the proportion of water supply to total project cost, and with postponement of obligation of consumers for repayment until time of use.
7. Repeal provisions of the Appropriations Act of 1938 (Public Law No. 208, 75th Congress, 1st session) applicable to water supply which conflict in a number of instances with the preceding provisions.

The problems of funding, water rights, federal and non-federal participation, cost allocation, and cost reimbursement in connection with water supply projects promise to at least equal those encountered in any other branch of water resources development. The primary responsibility for the financing of water supply facilities lies properly with the local communities and states involved. However, as a nation we cannot afford to neglect opportunities to assure our future water supply, which may mean that the Federal Government must assume some part of the cost burden.

The Watershed Protection and Flood Prevention Act of 1954 (Public Law No. 566, 83rd Congress) authorized the small watershed program of the Department of Agriculture. Because of its potential relationship to comprehensive, basin-wide planning, this program should not be overlooked in the consideration of future water resources policy.

The flood problem in small watersheds is important in the aggregate. The flood damages in a single headwater valley may be small, but when all the damages along the many miles of headwater streams in the nation are added together, the total is substantial. The planning of small watershed projects should be coordinated with comprehensive, basin-wide programs to the degree required to insure sound, well-conceived developments without duplication or interference.

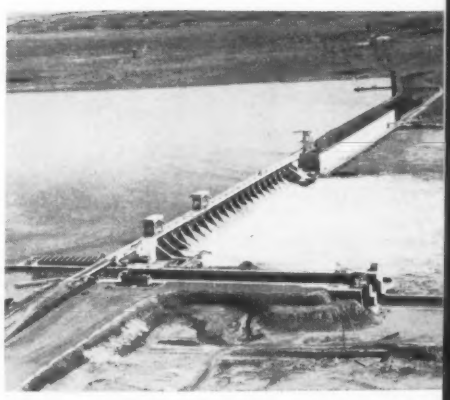
Coordination and review

In order to carry out a successful water resources program there must be close coordination between the states and the various federal agencies involved, as well as an adequate review of reports and projects, particularly with reference to interagency aspects. The Corps of Engineers strongly favors close coordination between federal agencies, and between the Federal Government and the states.

It is believed that adequate provision for review of reports and projects already exists within the Corps, as reports prepared by the District Engineers are reviewed in turn by the Division Engineers, the Board of Engineers for Rivers and Harbors, and the Chief of Engineers. Each report is subject to careful scrutiny at each level of review. The need, however, for more coordination and better review at the executive level as well as at field level, of the interagency aspects of plans and programs, is recognized in the recent recommendations of the Presidential Advisory Committee.

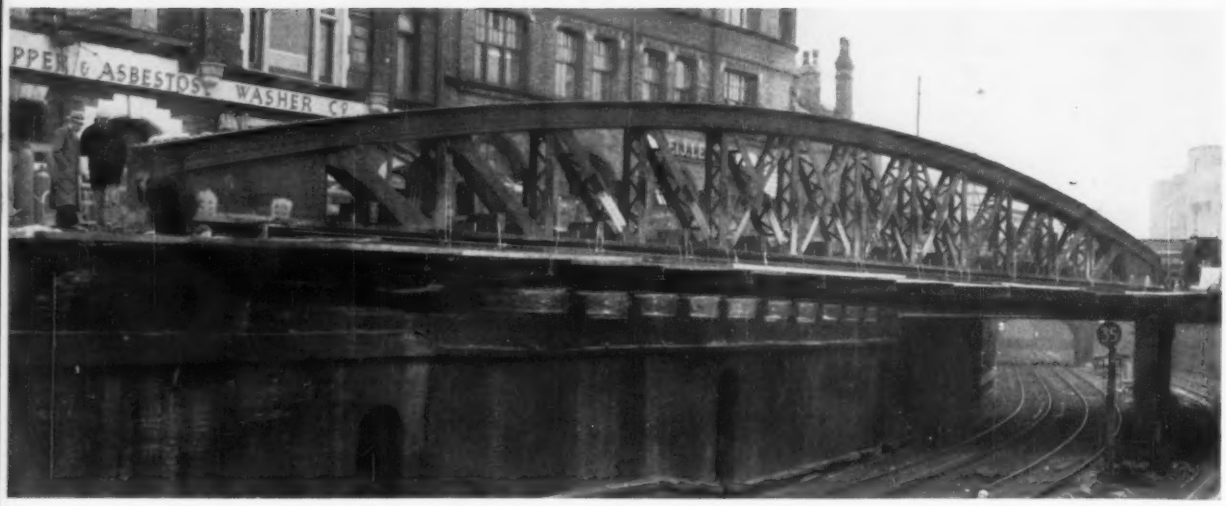
In conclusion, the Corps of Engineers considers that the objective of river-basin development is to make possible the use of the available land and water resources in the way most advantageous from an over-all public viewpoint. Planning should be done by river basins or appropriate regions. Our water resources policy should be dynamic and fully capable of adaptation to our rapidly changing needs. Adequate provision must be made for flexibility in future uses of water. Because of the many inherent advantages in multiple-purpose development of meeting effectively the needs of flood control, navigation, hydro power, irrigation, domestic and industrial water supply, and other water uses with a minimum of conflict and with much greater economy, we have every reason to expect that, in the main, future development of water resources will be by multiple-purpose means.

(This article is a shortened form of the paper originally presented by Past President Hathaway at ASCE's Knoxville Convention, in the Symposium on Multiple-Purpose River Development at the General Technical Session, presided over by C. E. Blee, M. ASCE, Chief Engineer of the TVA.)



McNary Dam, 292 miles above mouth of Columbia River, includes world's highest single-lift navigation lock (foreground). Powerhouse, at far side of spillway, will generate enough power for a city of 750,000. Both photos in this article are used by courtesy of Corps of Engineers, Department of the Army.

PRESTRESSING restores weakened



Fifty years of exposure to corrosive gases from steam locomotives had weakened this bridge in Birmingham, England, which carries Livery Street over tracks of British Railways. Bridge was restored to better than its original strength by reconstructing the deck and prestressing the truss girder

British Railways have perhaps been the first to make practical use of prestressing for the strengthening of existing steel bridges. Advantages of this method include economy and the fact that the work can often be done without interrupting rail traffic. Where the bridge to be strengthened spans railroad tracks, the possibility of avoiding temporary falsework may be of considerable importance.

A case in point is the renovation of the Livery Street Bridge in Birmingham, England. This bridge, which carries a busy thoroughfare over mainline railroad tracks, had been weakened by severe corrosion of the girder's tension chord by coal smoke from steam locomotives. By the prestressing method of strengthening, not only was the girder restored to its original strength, but its capacity was actually increased by 12 percent.

At the site, the railway, after running parallel to the street above, turns and curves under it at an acute angle. The cross girders which carry the bridge deck are supported at one end by a retaining wall. The other ends of these girders are carried by a single truss 115 ft long which extends from the retaining wall to a column bent between the tracks, as shown in photograph above. The cross girders are cantilivered 8 ft beyond the truss to support a walkway of that width.

Since the bridge was built, in 1906, corrosion had weakened the cross girders and the steel-plate deck floor as well as the bottom chord of the truss girder. Renewal of all the decking was inevitable. Fortunately highway traffic could be diverted along alternate routes, so replacement of the decking presented no problem. However, the headroom below the bridge and the clearances between tracks were very restricted, so that the 42-ton truss girder could not be removed for replacement nor strengthened in place by ordinary methods without very considerable interference with rail traffic. Such interference was largely avoided by using the prestressing method of renovation.

After the old decking had been removed and the new cross girders fitted into place, the sectional area of the tension chord of the truss girder was partially restored by substituting new mild-steel plates, fillet-welded in place, for the old outstanding legs of the flange angles, which had almost rusted away. Overhead portal frames spanning the footpath and attached to the extremities of three pairs of the cross girders were added to give lateral support to the top chord, and some mild steel lacing bars were added to some of the web members. Then, and before the new decking was placed, the bottom chord of the truss girder was prestressed with a load of 500 kips applied through eight high-tensile-strength Macalloy (Stressteel) bars of 1-in. diameter, with an ultimate strength of 155,000 psi. Four bars were placed on each side of the chord and anchored against massive welded steel brackets secured to the chord plates and to the outstanding flanges of the upper angles with high-strength bolts.

The jacking equipment was exactly the same as that used for prestressing concrete beams. Two 45-ton jacks were used to simultaneously stress corresponding bars, one on each side of the chord. The load applied to the first pair of bars was of course higher than that applied to the second, which in turn was higher than that for the third pair, and so on until eventually the load on each of the eight bars was the same. The stress in the bars is about 82,000 psi. Both before and throughout the stressing operation, the bars were temporarily supported on wires at intervals of about 15 ft throughout their length of about 90 ft.

A very necessary adjunct to the prestressing operation was the easing of the

truss bridge

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DONOVAN H. LEE, M. ASCE, Consulting Engineer, London, England

Welded steel brackets, one of which is seen in left foreground, provide anchors for high-strength alloy steel bars. White crosses, visible on diagonals, mark location of electric strain gages used to record stress changes in members during prestressing.

Macalloy (Stressteel) bars were jacked in pairs to apply load of 500,000 lb to bottom chord. After prestressing, rods were covered with canvas and bitumen and, together with bottom chord, encased in concrete.

expansion bearing so that the truss could shorten without restraint when the prestress was applied. The end of the girder was actually jacked up off its phosphor-bronze sliding plate bearing, which was cleaned and lubricated before the stressing began.

The effect of the prestressing was to shorten the chord by half an inch, while at the center the camber was increased by $^{7}/_{8}$ in. Stress changes in the chords and web members of the truss were measured and recorded during prestressing by electric resistance strain gages. The recorded changes were close to those calculated. Maximum totals indicated a reduction in tension of 10,500 psi in the tension chord, an increase in compression of 3,300 psi in the top chord, and an increase in compression of 1,800 psi in two of the web struts.

Subsequently the high tensile steel bars were wrapped in canvas and heavily coated with bitumen before being encased in concrete, which filled the whole chord and covered both sides.

The alternatives to this method of repair would have been the complete renewal of the truss girder or the restoration of the sectional area of the tension chord in situ—while the girder was relieved of all dead-load stresses—by welding or riveting on new mild steel. Under the most favorable conditions, the cheaper of these alternatives would have involved an expenditure at least five times that of the prestressing method adopted.

When strengthening a span by duplicating the girders or by adding new steel to the girders, it is usual to apply forces acting against the existing girders so that the stresses in the metal are either much reduced or even made opposite to those induced under the design load. Generally speaking, in strengthening any girder work, the stress in the metal is reduced by the application of forces acting contrary to those which induce the design load stresses. In fact, the metal is prestressed. The practice of reducing secondary and deformation stresses in new long-span truss girders by contra-straining the chords and web members during assembly on camber jacks is of course well known, but is not applicable to the strengthening of existing bridges.

Whether an existing bridge truss must be removed or whether it can be strengthened in position by the addition of new mild steel depends on local conditions, but in either case the work involved is considerable and cannot be carried out without inconveniencing the traffic using the bridge. Prestressing by the use of high-tensile-strength steel affords a simpler method of strengthening existing wrought-iron or mild-steel truss bridges. The amount of high tensile steel needed is extremely small compared with the tonnage of steel that would otherwise be required to accomplish the same degree of strengthening.

The possibility of obtaining economy by the prestressing of new steel lattice girders has been shown in CIVIL ENGINEERING by the late Gustav P. Magnel, M. ASCE (October 1954, p. 38) and by L. Coff, M. ASCE (November 1950, p. 64). Other uses of prestressing steel have also been reported, for example, by F. J. Samuely (*Structural Engineer*, February 1955).

An excellent mathematical analysis of the possibilities of prestressing steel was given by Magnel in the Belgian periodical, *L'Ossature Metallique* (No. 10, October 1953), but whether there would be any true economy for spans of less than 150 ft is controversial. Also, if wire of 0.2-in. diameter and about 220,000-psi ultimate strength were used, the vulnerability to corrosion and to fire hazards and accidental damage would call for special consideration, as pointed out by Donovan Lee in a discussion in CIVIL ENGINEERING (Jan. 1955, p. 62)

Wall forms and reinforcing steel are being laid out on casting platform, above, after application of bond-breaking compound. This platform is kept about 6 ft inside of future walls. In view at right, a wall section is being lifted by crane from casting platform. Bond-breaking compound permits several wall sections to be cast on top of one another. As many as three were so cast. Note adjustable stiff-legs already attached to panel as well as four rings for lifting.

A. GEORGE MALLIS, M. ASCE

Munson and Mallis, Inc., Architectural Engineers, Springfield, Mass.

Economy plus architectural appeal with

An interesting building from the point of view of both construction and architectural treatment is the factory and office building recently completed to house the Colonial Engineering and Manufacturing Company in Springfield, Mass. There is an experimental machine shop on the ground floor and general offices and drafting room on the second floor. This building is about 85 ft wide and 120 ft long, covering approximately 11,000 sq ft per floor, or a total of 22,000 sq ft of area. Its total cost excluding site work, was $116,000, averaging $5.30 per sq ft. The general contractor was the Ley Construction Company of Springfield, Mass.

On the first floor of this two-story building are the machine shop, reception lobby, shop offices, shop toilets and utility rooms. The second floor includes a large drafting room and the general and private offices of the firm. Exterior walls are reinforced concrete with a small brick section at the entrance for architectural interest. Continuous steel sash was used for the entire second story. The first floor is reinforced concrete on grade and has no special finished flooring except in the lobby and offices. The second floor is wood plank, supported on steel beams, girders and columns, and is finished with asphalt tile flooring applied over the plywood subbase.

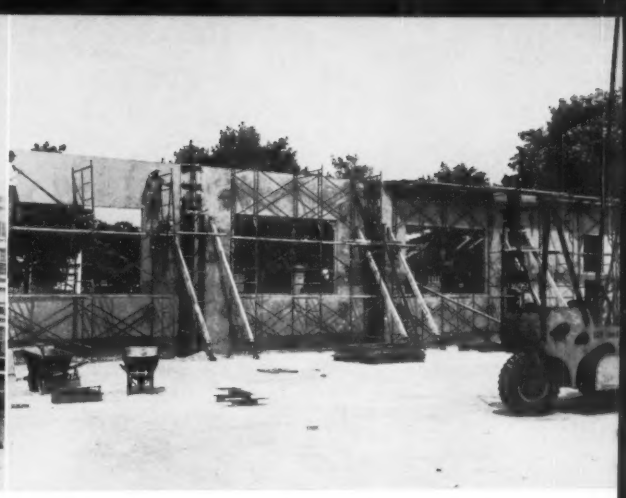
The built-up roof, over insulated steel deck, is supported on steel beams and built of steel trusses, spanning the 85-ft width of the building so that there are no columns on the second floor. The entire second-floor ceiling and first-floor lobby ceiling is acoustical fiber-glass tile in what might be called a T-bar suspended system. The rest of the first-floor ceiling is exposed wood planking.

The reinforced concrete walls were erected by the tilt-up method, each wall section being cast directly on the first-floor slab and lifted into position after curing. Each wall slab was approximately 18 ft 18 in. wide by 22 ft 6 in. high, reinforced with No. 4 rods and cast with 3,000-psi concrete. Finishing was by a rotary float machine and mechanical vibrator, and final finish was by steel trowel. Openings were left in each slab as required. Great care was taken in placing the first-floor slab to insure a rigid, smooth casting platform. Initially, all top soil was removed from the building site, and the subgrade of the proposed floor was carefully compacted. A well compacted layer of not less than 6 in. of gravel was then placed on the prepared subbase.

The floor slab consists of 5 in. of 3,000-psi concrete reinforced with welded wire mesh. It was carefully finished with a steel-trowel float machine to a dense, even surface. When it was hard, a curing coat of bond-breaking compound was applied with a hand sprayer. This compound provided the breaking agent for the tilt-up slabs in addition to curing the floor slab. The floor slab was poured and finished in sections, the tilt-up wall formwork being started as soon as each section was hard enough to work on. A second coat of bond-breaking compound was applied to the finished floor slab and forms before any reinforcing steel was placed in the forms. When this application was dry, the reinforcing steel and lifting inserts were placed in position, the 3,000-psi concrete was placed in the forms, and this was vibrated and finished off with a steel trowel. Wall slabs were covered with curing compound.

The wall slabs were arranged on the casting platform so that they could be lifted by a crane operated on the casting floor. The limited size of the casting floor made it necessary to place as many as three wall sections on top of each other, separated of course by the bond-breaking compound.

Slabs were lifted from the casting floor with a 35-ton crane, using a four-point lift with spreader bar. Before it was lifted, two adjustable stiff legs were attached to each wall section, the purpose being to plumb the slab after erection and to maintain it in position while the cast-in-place reinforced con-



When panel is placed on previously leveled concrete footing, as shown above, stiff legs are adjusted and anchored to hold-down bolts in casting floor. When all slabs were in place, cast-in-place reinforced concrete columns were poured between them to form a monolithic structure. In view above, column forms are ready to receive concrete joining adjacent slabs.

TILT-UP *construction*

crete columns were completed. Each lifted slab was carefully positioned on previously leveled concrete footings. This leveling was accurately done by means of instruments and a mortar leveling bed. When each slab was in position and plumbed, the stiff-legs were anchored to hold-down bolts placed in the casting floor.

When all the slabs had been lifted, the cast-in-place, reinforced concrete columns were erected, making a monolithic structure. After the completion of the concrete walls, the steelwork was erected in the usual manner.

It is interesting to note that the cost of the reinforced concrete work was approximately $1.00 per sq ft in place, which compares very favorably with the cost of a cinder-block wall, commonly used in this area for inexpensive exterior wall construction. The two principal reasons why tilt-up construction was more economical were, first, that this type of construction reduced labor cost, and second, that it reduced construction time.

The general contractor for this work was the Ley Construction Co. of Springfield, Mass. The writer wishes to express his gratitude for the fine cooperation between engineers and contractors which resulted in the successful completion of this unusual construction at such a low price.

With cast-in-place concrete columns practically complete, wall is ready to receive structural steel framing for second floor.

Finished building of Colonial Engineering and Manufacturing Company, in Springfield, Mass., houses machine shop on ground floor and offices and drafting room on second floor, which is enclosed entirely with continuous steel sash.

Seven-Million-Dollar Water Works

C. E. PAINTER, M. ASCE

The seven-million-dollar water works of Virginia City, Nev., was constructed in the 1870's. As about $400,000,000 in gold and silver was taken out of Gold Hill and the Comstock Lode, near Virginia City, in the late nineteenth century, the water works did not seem so expensive at that time. If it were built with modern dollars the cost would be considerably more, as the value of gold has risen from $20.35 to $35.00 an ounce since that time, and labor and materials are of course a great deal higher than they were in the 1870's.

When Virginia City was a boom town it housed from twenty to forty thousand people, but the 1950 census showed a population of 952. On the basis of today's population there is a lot of capital invested per capita in the waterworks system.

Virginia City, Nev., is located in the Virginia Range a little northeast of Carson City and southeast of Reno, not very far from either community, on the eastern slope of Mt. Davidson at an elevation of 6,340 ft above sea level. This is a desert region. Some winter storms from the west get over the high Sierra Nevada to blanket the area with snow. These contribute to the meager surface runoff and feed some small springs. An insignificant amount sinks into the underlying rock of the mountain.

Why this investment in water?

How did a pioneer mining town come to invest seven million dollars in a water supply system? To answer this question it is necessary to go back to May 1850, when a party of California-bound gold seekers stopped their wagon train to camp briefly on the banks of the Carson River at the mouth of Gold Canyon, near where Dayton is now located. (See map, Fig. 1.) One of the party, panning some sand to pass the time, found particles of gold. In the next nine years, placer miners took several hundred thousand dollars worth of gold dust from Gold Canyon.

These operations led, in the spring of 1859, to the discovery at Gold Hill of the great vein known as the Comstock Lode, rich in gold and silver. Surface operations were continued underground. The rush was on. Mills were built. By the summer of 1862 the population of Virginia City had grown to 15,000. The 52-mile Virginia and Truckee Railroad was completed in November of 1869.

Wherever tunnels were dug, some water was found, and it was in great demand. The value of the water often was greater than that of the ore, which was everywhere sought for and sometimes not found. The demand for water for domestic use and for the mines and mills exceeded the supply. The Virginia and Gold Hill Water Company, which controlled the meager supply to the Comstock Lode, attacked the problem of bringing in additional water. Ground water was not available. To pump from the Carson River, six miles away and 1,700 ft below the elevation of Virginia City, would have been a prohibitively costly enterprise.

A gravity supply was therefore sought, and it was found 30 miles to the west, in the high Sierra Nevada range. But between the Sierras, bordering on Lake Tahoe, and the Comstock Lode was the deep geological trough known locally as the Washoe Valley. Any aqueduct carrying water to Virginia City would have to cross this depression, lying 1,200 to 1,500 ft below the city. A number of technical difficulties would have to be overcome if such a project were to be successfully accomplished. But the directors of the Virginia and Gold Hill Water Company, all of them mine or mill owners, did not hesitate long. They reached their decision in August of 1871, and instructed their superintendent, J. B. Overton, to proceed with the construction of the aqueduct.

The project is shown in Fig. 1, where its various parts are indicated by numerals, which are referred to in the following description. The first source tapped was Hobart Creek, (1), on the eastern slope of the Sierras, where a small storage dam was built. A 4-mile line of 18-in. wooden box flume, (2), was constructed along the grade contour to a point overlooking Washoe Valley, (3), about 1,885 ft above the railroad tracks at Lakeview.

Methods of constructing wooden flumes were well known but the technique of crossing a valley 7 miles wide and more than 1,700 ft deep with an inverted siphon pipe, (4), called for engineering and manufacturing skill not generally available in 1873. From the outlet of the siphon, (5), a 9-mile wooden flume, (6), 16 × 18 in., conveyed the water to Virginia City and Gold Hill.

A pioneering siphon

This siphon sustained "the greatest pressure in the world" according to an article entitled, "Hydraulic Engineering on the Pacific Slope," which appeared in the *Mining and Scientific Press* of December 13, 1873, a weekly published by Dewey & Company in San Francisco. The following account of the design of the siphon pipe, the profile of the siphon reproduced in Fig. 2, and the pipe details reproduced in Figs. 3, 4, 5, and 6, are taken from that article. It was based on information furnished to the then editor, W. B. Ewer, by a young hydraulic engineer, Hermann Schussler, an 1862 graduate of the Prussian Military Academy of Oldenburg who, following graduation and before coming to this country, had studied civil engineering in Zurich and Carlsruhe.

Serves Less Than a Thousand People

Vice President and Consulting Engineer, Waterworks Equipment Company, Salt Lake City, Utah

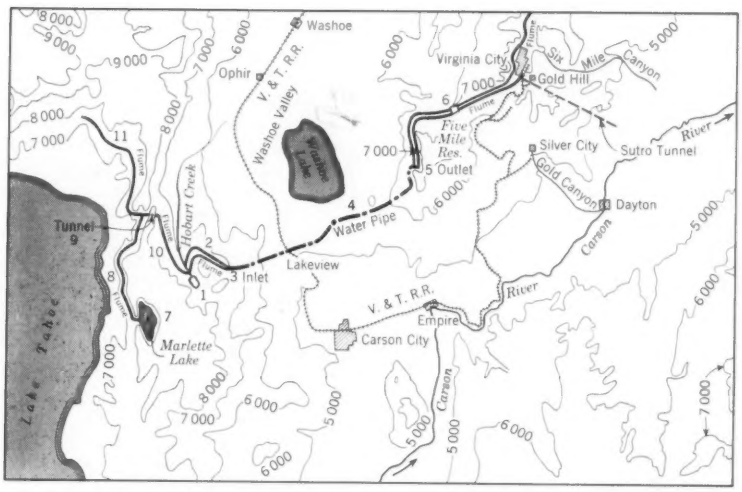
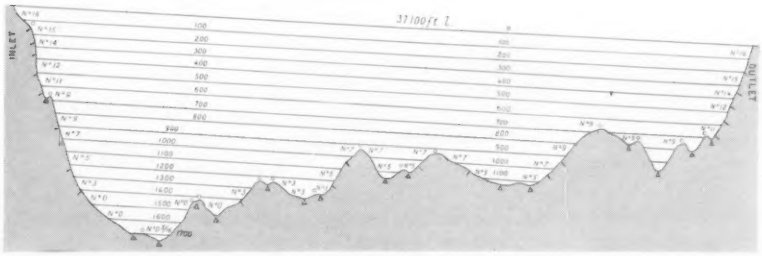


FIG. 1. Virginia City obtains its water supply from Sierra Nevada range 30 miles to the west by means of system of conduits, pipe siphons, and a tunnel. Various features of this system, built in 1872–1887 at cost of about 7 million dollars are numbered on map for reference in text. Map is based on U.S.G.S. sheet, "Nevada Carson, 1893."

FIG. 2. Washoe siphon, shown in profile, carries water across Washoe Valley to Virginia City. Siphon diameter is $11^1/_2$ in. Increases in thickness of plates with rise in pressure head are indicated in Birmingham gage numbers. Location of relief valves is also shown. This profile and the accompanying Figs. 3, 4, 5, and 6, were prepared by Hermann Schussler, designer of siphon, and are reproduced here from *Mining and Scientific Press* for December 13, 1873, pages 376 and 377.



In 1864 Schussler entered the service of the Spring Valley Water Company of San Francisco, and soon became its chief engineer. After completing the Spring Valley works he designed other large water works on the Pacific Coast and achieved a considerable reputation as a hydraulic engineer. When he was engaged to design the Washoe Valley siphon he had already designed and built several siphons for California placer mining companies. The one he built for the Cherokee Hydraulic Mining Company in 1870 sustained 930 ft of water head, making it the greatest that had been built up to that time. The quantity of water to be carried by the Washoe siphon to Virginia City was less but the pressure was greater—said to be the greatest ever before dealt with in a structure of this kind.

The siphon pipe was fabricated from Scotch iron plates 36 in. long, made in England, rolled to a diameter of $11^1/_2$ in. and lapped sufficiently to permit two longitudinal lines and one circumferential line of $^5/_8$-in. hot rivets to be driven. The shop length of the pipe sections was 26 ft 2 in. Manufacture of the pipe by the Risdon Iron and Locomotive Works of San Francisco required nearly a million rivets. The profile, Fig. 2, shows how the thickness of the plates was changed with the pressure from a Birmingham gage of No. 16 ($^1/_{16}$ in.) at the top to No. 0 ($^5/_{16}$ in.) at the point of greatest head, where the pressure was 800 psi. According to the best information available, the metal in the pipe was stressed to approximately 13,500 psi.

Special provision was made for thermal expansion and contraction of the pipe by placing a lead-calked slip joint between every two lengths of pipe, as shown in Fig. 3. The joints required 35 tons of lead, but they began to leak soon after the pipe was in place as a re-

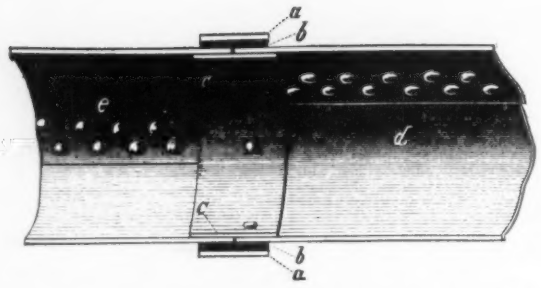


FIG. 3. Every other joint in first siphon pipe is lead-calked slip joint to take care of expansion and contraction. (Other joints are riveted.) Wrought-iron collar, *a*, is 5 in. wide, leaving annular space of $^{3}/_{8}$ in. for lead, *b*, which was run in and calked from both sides. In one end of each pipe section, 6-in. nipple, *c*, was riveted.

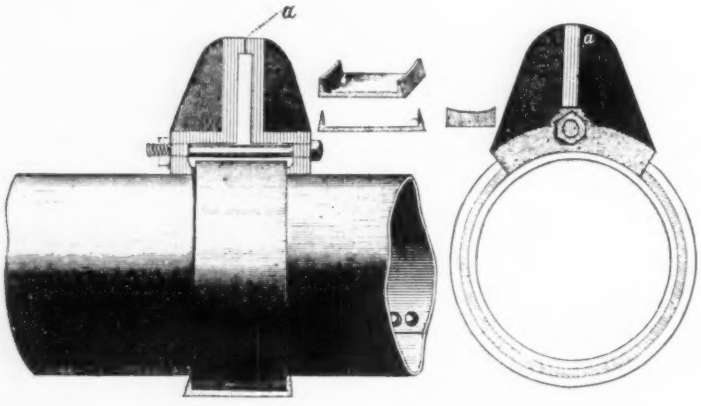


FIG. 4. During first few months of operation of siphon in 1873, expansion and contraction of pipe loosened lead calking, causing leaks. These were eliminated by use of clamps here illustrated, which pushed lead back into place and held it there.

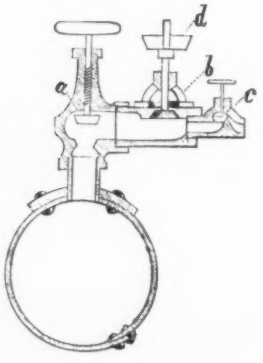


FIG. 5. Self-acting air valves installed at high points in line prevented vacuum formation. Accumulated air was blown off through hand-operated valve, *c*.

sult of loosening of the lead by the movement of the pipe. A clamp, Fig. 4, devised to force the lead back into place and keep it there, stopped the leaks. It is to the credit of the fabricator that none of the riveted joints leaked; in fact a piece of pipe and a joint were tested in the shop before shipment to 1,400 psi.

Many difficulties overcome

"Crossing the gorges and spurs was a difficult matter to carry out," states the article in the *Mining and Scientific Press* previously referred to. This is not hard to believe.

In order to protect the pipe, hand-operated blowoff valves were placed at sixteen low places in the profile. And at each of fourteen high points a self-acting air relief valve was installed, as shown in Fig. 5. The manner of strapping elbows and pipe sections together at short curves to prevent outward movement is shown in Fig. 6.

Before the pipe was laid, it was immersed in a bath of 20 percent asphaltum and 80 percent coal tar heated to 350 deg F. The 1,700 tons of pipe lengths were shipped by rail from San Francisco to Lakeview Station on the Virginia and Truckee Railroad. The pipe was laid in a trench about 4 ft deep.

From the time manufacture of the pipe commenced, early in 1873, until water was delivered to Virginia City, only 5 months elapsed. The first joint was laid in June of 1873; the last, six weeks later, on July 25. Four days later water was turned into the pipe, and when it actually flowed into Bullion Ravine, the people of Virginia City were "as wild with joy as were the Israelites when Moses smote the rock. Cannons were fired, rockets went up, and bands paraded the streets." So stated Grant H. Smith in his "History of the Comstock Lode," to be referred to later.

Second and third siphons constructed

Although the design capacity of the siphon was 2.3 mgd, it could not keep up with the enormous growth in the de-

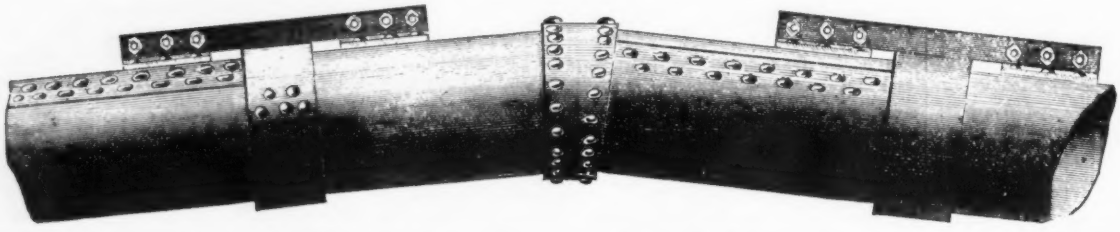


FIG. 6. Riveted elbow joints in siphon provided for short curves across gulleys and around sharp cliffs. Where curve was sharp enough to require that precaution, angle irons were riveted on outside of curve and connected with iron straps across joint.

mand for water for operating the mines, for fire protection, and for industrial and domestic use. A second line of flumes from Hobart Creek and a second siphon pipe approximately parallel to and duplicating the first were therefore built in 1775. The second pipe, of 10-in. diameter, was lap welded and had screwed joints.

In anticipation of the growth in the demand for water, the directors of the Virginia and Gold Hill Water Company had early obtained possession of Marlette Lake lying on the western slope of the Sierras, (7) in Fig. 1, at an elevation of 8,000 ft, and had enlarged it by raising Marlette Dam. From Marlette Lake a 14- by 30-in. flume was constructed northward along the grade contour for about 4.3 miles, (8), to the west portal of a 3,994-ft tunnel through a granite divide, (9), to Hobart Creek Valley. Thence a 3-mile flume, (10), connected with the flume previously built leading to the intake of the siphon pipe. The $5\frac{1}{2} \times 7$-ft tunnel from Lake Marlette was holed through on May 13, 1877. In addition, the flume was continued northward from the west portal, (11), for 8.25 miles to pick up additional runoff from the west slope to add to the supply from Marlette Lake.

Many of the facts here recorded are taken from an interesting account entitled "Early Engineering Works Contributory to the Comstock" (Geology and Mining Series, No. 45, University of Nevada, June 1947), written by the late John D. Galloway, Hon. M. ASCE, who lived as a boy in Virginia City and took a great interest in its water works. Mr. Galloway states that:

"In 1887 a third pressure pipe was laid across the Washoe Valley depression in substantially the same location as the first two pipes. It was made of lap-welded pipe similar to the second pipe, except that the joints were of the lock-joint type. The pipe walls were $\frac{3}{16}$ to $\frac{3}{8}$ in. thick, and the length is 37,685 ft. . . .

"When completed the water system included three reservoirs, over 21 miles of pressure pipe across the Washoe depression, 46 miles of covered box flume, and the tunnel 3,994 ft in length. Much of the construction was carried out at an elevation above 7,000 ft, where in winter snow covered the ground in depths from 10 ft up."

A notable accomplishment

All the water works here described were designed and built by J. B. Overton, superintendent of the water company, except that the first inverted siphon was designed by Hermann Schussler, as previously stated. "As built," wrote Mr. Galloway, "the [Virginia City] water supply was a notable addition to the art of water supply engineering."

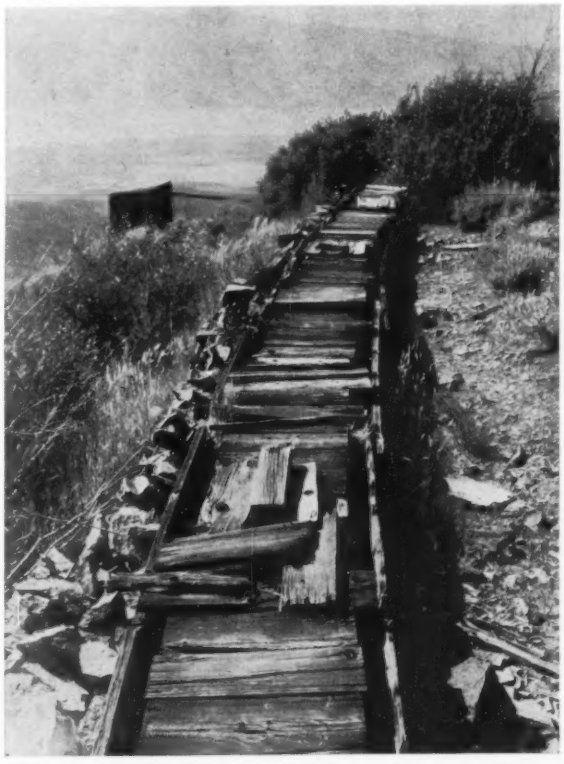
The distribution system includes approximately 87,000 ft of pipe, originally no larger than 4 in. in diameter but later replaced with pipe of 4 to 10-in. diameter. There are 75 fire hydrants in the city, most of them of the obsolete single-outlet type, attached directly over the main and providing a static pressure of 160 psi. Several equalizing reservoirs and storage tanks located at strategic points complete the system.

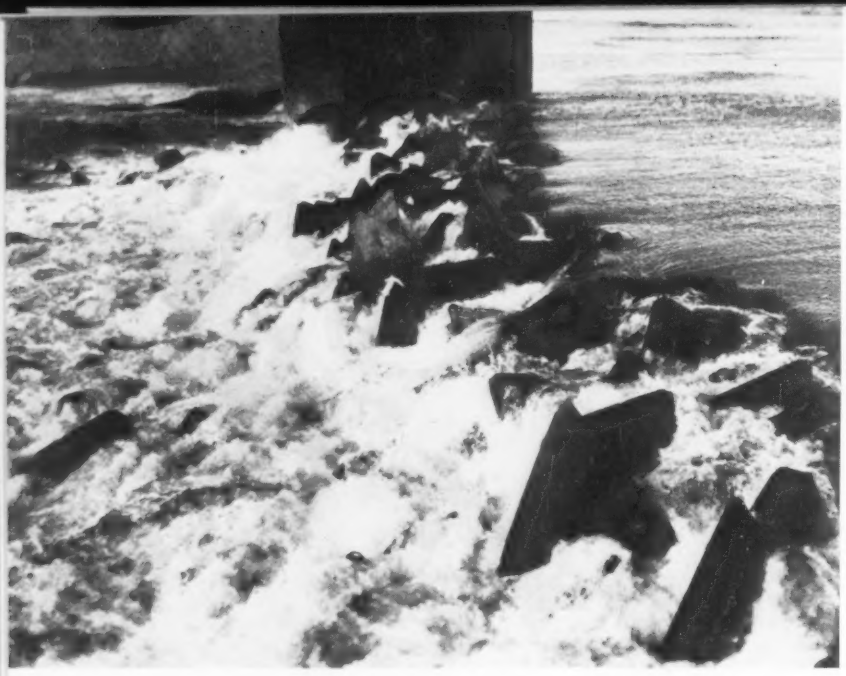
"The glory of the Comstock passed with the year 1880, and with it a life as high-spirited, colorful, and romantic as that in 'the days of forty-nine,' " wrote Grant H. Smith, whose "History of the Comstock Lode, 1850–1920" (Geology and Mining Series, No. 37, University of Nevada, July 1, 1943) has been previously referred to. Mr. Smith was a San Francisco mining attorney who had spent his youth on the Lode. He dedicated his history of it to John W. Mackay, famed mining engineer and one of the four men who in 1871 gained control of the Consolidated Virginia, richest of the Comstock mines. The other three were James G. Fair, James C. Flood, and W. S. O'Brien. These four, known as the Bonanza Firm, with three others, were the directors of the Virginia and Gold Hill Water Company. All made fortunes.

Only one of the Washoe siphons is now in use supplying water to Virginia City. The others have been abandoned because of corrosion around the rivets. The covered wooden conduits are deteriorating with age and use, and in winter are likely to be frozen tight. A winter that passes without interruptions to service is rare. Currently the flumes are being replaced with pipelines.

During the Society's search for the seven civil engineering wonders of the United States, the Sacramento Section named this pioneer water-works system as one of its choices for that distinction. Considering the difficulties that had to be overcome in those early days and the record-breaking pressure supported by the pipe in the remarkable siphons, the Section's nomination is easily understood.

Covered wooden conduit carrying water to Virginia City has deteriorated with age and in winter is likely to be frozen tight. Currently conduits are being replaced by pipelines, but completion of this work will require several years. Photo courtesy *The Territorial Enterprise,* Virginia City.





B. E. TORPEN, M. ASCE

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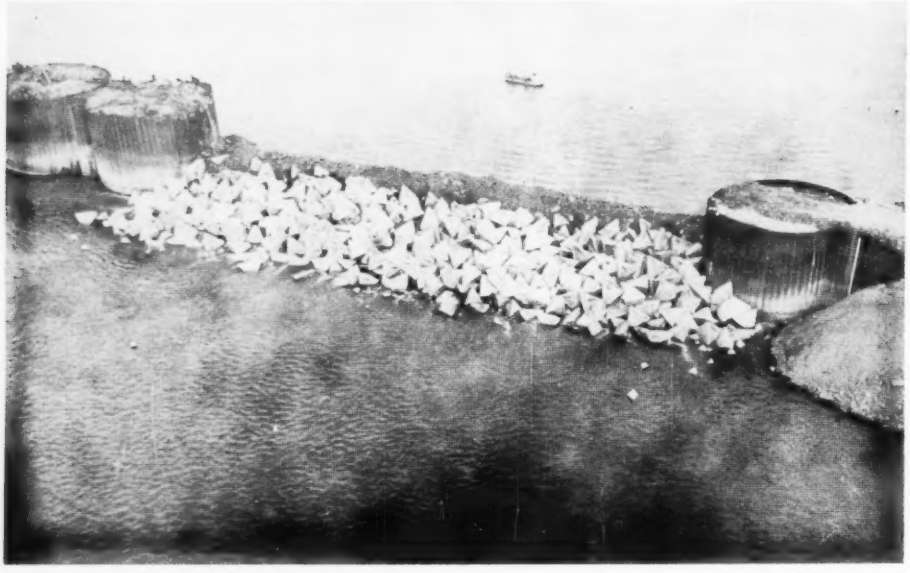

To close McNary Dam, more than two thousand 12-ton concrete tetrahedrons were first dumped in, as shown in top view. Next step was to place 28,000 tons of one-ton stone plus 45,000 tons of rock spalls in alternate lifts, producing result shown in middle view and in distant view below. Materials were dumped from skip on movable cableway.

LARGE ROCKS

in river control works

The type of material selected for cofferdams, closures, river diversions, dams, and allied works, is usually determined by the availability of materials at reasonable cost, and by the size of the stream, the gradient, depth, current velocities and past experience of the operator.

The United States section of the main stem of the Columbia River is rapidly being developed by multiple-purpose projects, many designed and constructed by the Corps of Engineers, U.S. Army. Stones of large size have been successfully used in many of these structures, and their use on five of these projects will be discussed here.

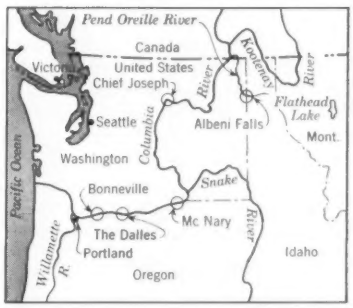

FIG. 1. Five projects discussed in this article are circled on map of Columbia River.

McNary closure with 12-ton tetrahedrons

Closure of McNary Dam, on the main stem of the Columbia River, was an outstanding achievement. It exemplifies bold planning based on experimental research and competent construction based on careful preparation. It provides a full-scale model for other diversions under similar difficult conditions on major rivers.

The channel to be closed was 240 ft wide and the rock channel was 53 ft deep with overhanging walls. The river flow fluctuated between 100,000 and 157,000 cfs, with a head differential of 16 to 18 ft. A rise in water level of 17 ft was required to force all the water through the spillway bays. After closure, and to protect against overtopping, the cofferdam had to be 90 ft high, and because of this height and the overhanging rock walls, a timber crib or steel-cell construction was discarded.

Closure was accomplished by placing 2,088 twelve-ton concrete tetrahedrons, and approximately 28,000 tons of stone with a minimum weight of one ton, plus 45,000 tons of rock spalls in alternate zones and lifts. The materials were placed by dumping from a skip on a movable cableway. The fill was brought up through the water in 29 days of working time and success was assured. After 3,000 tons, or 40 percent of "C" stone (spalls up to one ton) was placed, the flow through the voids was 10,600 cfs. See accompanying photographs.

After completion of the second C-stone fill, the flow was 2,500 cfs with a head differential of 16.7 ft. (Q in river = 125,000 cfs.) After the gravel blanket was placed, the seepage was cut to 850 cfs with a head differential of 16.6 ft (Q = 117,000 cfs). After the impervious fill was placed and the cofferdam pumped out, the head differential was 58.8 ft and the seepage only 56 cfs. The downstream slope of the tetrahedron fill as built was about 1.0 vertical on 2.0 horizontal.

The cost of the closure was about $1,267,000 and hydraulic models and studies cost $52,000.

This closure was fully described in a Corps of Engineers, U.S. Army Report, "Closure of the Second-Step Cofferdam, McNary Lock and Dam," July 1951. It has recently been briefly described in the *Proceedings* of the ASCE, Separate No. 639, March 1955, by L. E. Rydell and G. H. Von Gunten.

Repair of Bonneville cofferdam

The cofferdam for Bonneville Dam was being constructed in 1934, and the shoreward 120 ft of each leg of the north cofferdam was an earth fill heavily protected with riprap. Before the downstream leg could be completed, an unprecedented flood overtopped the upper leg, and the 8-ft head differential washed out the rock-protected, shoreend fill in a few hours. The shore was protected from scour by dumping 10- to 20-ton jetty rock but the repair of the

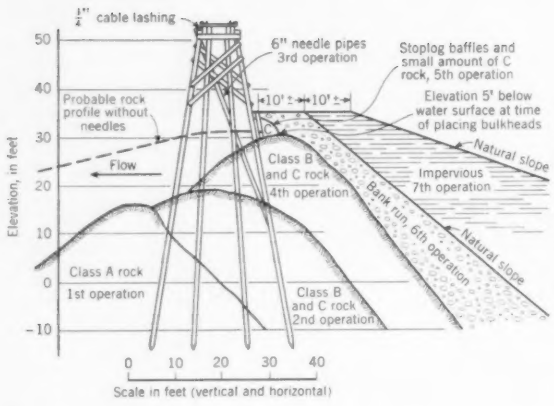

FIG. 2. Rock cutoff for Bonneville cofferdam is shown in cross section. Class A rock is 10- to 15-ton size, Class B rock is 1- to 5-ton size, and Class C rock is spalls up to 1-ton size.

cofferdam was not so simple. The 75-ft depth of water caused by the scouring action and the high velocity through the gap precluded the use of normal closure methods without covering part of the foundation on which the future dam was to be constructed.

Starting from the shore some 400 ft upstream, a piling trestle was constructed upstream of the gap as far as the last remaining timber crib of the main cofferdam. Then 10- to 30-ton rocks were dumped from flat cars on the lower side of the trestle and smaller rock on the upper side. Finally gravel and an impervious blanket were added for water tightness. A material saving in rock was effected by placing heavy 6-in. pipe needles between bents, and by using timber bulkheads to support the upper 5 ft of fill (Fig. 2). Seepage through this fill was only about 15 cfs. The cost of the closure was about $150,000.

Second-stage closure for Chief Joseph Dam

At the Chief Joseph Dam site on the Columbia River, the granite bedrock was overlain by only a few feet of gravel and boulders. In constructing the sheetpile cells for Cofferdam No. 1, considerable trouble was encountered in erecting and holding the cells with so little overburden, and from fill material escaping through "windows" in the cells at the bottom.

The contractor for the second-stage closure used rock-fill groins to close the river, forcing the flow through sluices and over the low monoliths constructed within the first-stage cofferdam.

A river discharge of 70,000 to 100,000 cfs was expected during the closure operation, which called for a very tight time schedule. The contractor selected the end-dump closure method even though he recognized that physically this method would be appreciably more difficult to complete than a conventional closure, in which the bottom would be raised uniformly over a considerable length of weir section. His choice was made on the basis of plant limitations and estimated costs.

A 1:80 scale model of the project at Bonneville Hydraulic Laboratory was used to determine probable closure heads, velocities, and probable rock sizes and slopes for various end-dump plans. It was found that for a flow of 100,000 cfs the maximum head differential would be 9 ft, with theoretical stream velocities of 20 to 24 fps at critical openings of the closure gap, and that with 1-ton to 3-ton rock, the downstream slope of the fill would be 1 on 3 to 1 on 5. With this downstream slope, a large part of the toe of the closure fill would overlay the construction area within the second-stage cofferdam and require expensive excavation.

Three additional cells in the upstream and downstream arms of the first-stage cofferdam would also have to be removed before attempting the closure. The contractor's plan called for a dike composed of two rock-fill groins to be constructed by end-dumping, beginning at the left bank and extending to the center leg of Cofferdam No. 1. To avoid scouring of rock from the upstream groin into the area between the two groins, which would hamper driving of the second-stage sheetpiling, the downstream leg led the upper leg by a considerable margin. Thus most of the head loss occurred across the downstream leg, as shown in the accompanying photograph.

The downstream leg was pushed to within 50 ft of Cell No. 8 using random-size rock fill varying from 1 to 5 tons. Velocities through the closure gap were approaching 20 fps, and only selected rocks of 15 to 20 tons would remain in the closure gap. A large stockpile of these rocks had been assembled.

To prevent rock from washing downstream during the final closure, the contractor rigged a cable from Cell No. 7 to a deadman in the groin and strung lines from the cable to selected rocks placed in the closure gap.

Each large rock had been fitted with a so-called "hairpin" sulphured into holes drilled into the rock. Using the hairpins, the rocks were secured to cables either singly or in pairs and pushed into the closure gap by a bulldozer. Occasionally the hairpins would slip from the sockets while

In closure of second-stage cofferdam for Chief Joseph Dam, downstream groin led upper groin (left foreground) by a considerable margin. This was to prevent washing of rock from upstream groin into area between two groins, which would hamper driving of sheetpiling.

the rock was being placed and the rocks would roll downstream below the closure gap with a thunderous roar. A better anchorage for the large rocks could have been provided by drilling the holes entirely through them and tying the cables to the rock with a loop.

The contractor's method of cable anchorage for the final 50 ft of closure proved successful and economical. It substantially reduced the quantity of rock required for the closure by reducing the slopes from 1 on 3 to 1 on $1^1/_2$. During the flood period in June 1954 an armored facing of large rock tied into place with cables successfully withstood high velocities in protecting the powerhouse cofferdam for the Chief Joseph Project.

For a more detailed description of this work see "Report on Second-Step Closure Operation, Chief Joseph Dam, Columbia River," Office of the District Engineer, Seattle, Wash., September 1954.

Small-sized rock utilized at Albeni Falls

At the Albeni Falls Project on the Pend Oreille River there were three channels. The spillway dam was constructed before the powerhouse by building a simple rock-fill diversion dam while the main channel was still carrying the stream flow. To construct the powerhouse, it was necessary to divert the main stream by cofferdams, passing the river discharge of 15,000 to 20,000 cfs over the completed spillway dam.

The plan was to use steel cells for the upper powerhouse cofferdam and rock fill for the lower cofferdam—the materials to come from the spillway cofferdams, which consisted of 1- to 2-ton rock and gravels and fines. The contractor planned to construct the downstream cofferdam first by end-dump methods.

Theoretical studies indicated that the maximum head differential with this method would be 7 ft and the Isbash formula ("Construction of Dams by Depositing Rock in Running Water," by S. V. Isbash, 2d Congress on Large Dams, 1936) indicated that rocks weighing from 10 to 12 tons each would be required for closure, whereas the rocks available weighed only 1 to 2 tons, and there was a small stockpile of 4-ton rock.

The following description is taken from the Corps of Engineers, Seattle District, Report of October 1, 1954, "River Diversion for Powerhouse Construction—Albeni Falls Dam."

Further studies showed that closure could be effected using a long shallow section built up uniformly from the bottom and employing rock of the sizes available on the job. However, the contractor's equipment and plant layout were not suitable for this type of operation.

It appeared that the end-dumping method could be used if the downstream powerhouse cofferdam and an upstream diversion dike were pushed out alternately. By splitting the closure head between the two dikes, it could be kept to a maximum of 3 to 4 ft, which would permit the use of available material.

Excavation of the downstream spillway cofferdam had begun in February 1954, and the excavated material had been put into the fill for the downstream powerhouse cofferdam. On March 12, a section of the upstream spillway cofferdam was blasted out, and diversion over the spillway was begun. Both spillway cofferdams were excavated simultaneously, a concentrated effort being made to enlarge the opening in the upstream spillway cofferdam to increase the spillway discharge. Material excavated from the spillway cofferdams was a random-sized rock fill of 1- to 2-ton size, with occasional boulders of up to 5 tons. The rock in the fill material was interspersed in a matrix of saturated fines, gravels, sand and silt-like materials, which lubricated and greatly lessened the resistance of the fill material to stream velocities.

On March 12 about 130 ft of the closure section remained to be placed in the downstream powerhouse cofferdam. After an initial rapid placing of fill, the closure head built up to plus 3 ft on March 13, and sloughing of fill material from the end of the fill into the channel became so serious that the contractor diverted part of his trucks to construction of the upstream diversion dike. Early on March 14, with the head differential approaching 4 ft, it became impossible to hold end-dumped material at the lower powerhouse cofferdam, and all dumping was shifted to the upstream diversion dike.

By 3:30 p.m. on March 14 the head on the upstream diversion dike had increased to 3.4 ft and sloughing of end-dumped material made operations hazardous at the end of the dump. The contractor then switched to dumping at the downstream powerhouse cofferdam, where the head differential had fallen to 1.3 ft. Thereafter, he alternated between the two closure sections, using a head differential of approximately 3.5 ft as the basis for changing. The total river flow remained at about 17,000 cfs. Final closure was made at the lower cofferdam on March 20.

The river diversion work for the Albeni Falls powerhouse demonstrated the necessity for careful advance planning in order to execute such an operation successfully. In order to complete the diversion within the scheduled time, the contractor was forced to incur extra expense for overtime, as well as for bringing in additional equipment after the operation had been started.

As to the correlation of theoretical studies with actual operations, it was found that Isbash's formulas pertaining to the resistance of rock of various sizes to movement by high-velocity flow, provided an adequate basis for estimating probable conditions.

Downstream diversion dike for Albeni Falls powerhouse construction nears closure. Contractor succeeded in utilizing 1- to 4-ton rock mixed with miscellaneous material from spillway cofferdam, by end-dumping alternately in upstream and downstream diversion dikes. Original studies for this closure indicated need for rocks weighing from 10 to 12 tons, which were not locally available.

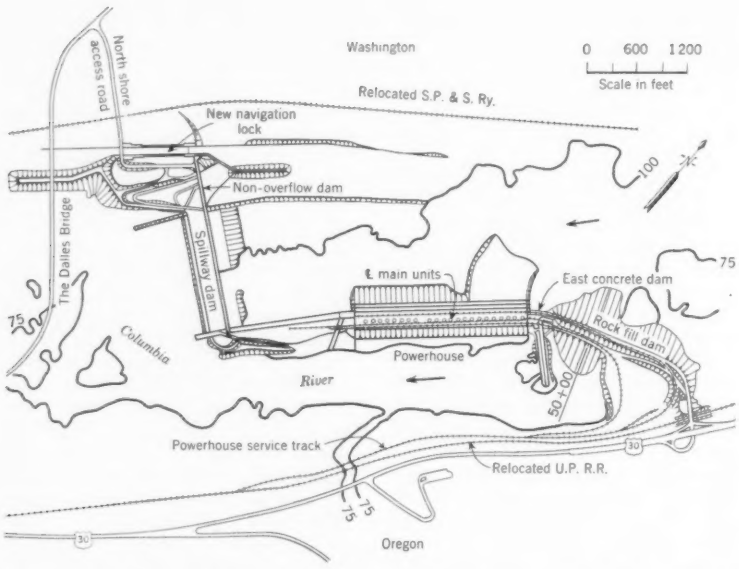

FIG. 3. Main features of The Dalles project are spillway, powerhouse, and main closure dam, marked rock-fill dam. Two former are now under construction and the latter will be closed in winter of 1956–1957. Photo shows current status of the work.

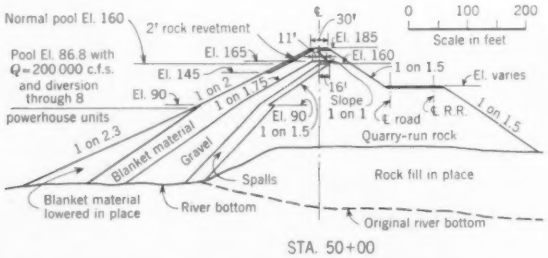

FIG. 4. Main closure dam for The Dalles Project, shown in cross section, is to be built without cofferdams. Material marked "rock fill in place" was excavated from spillway cofferdam and wasted into Columbia River at closure site in 1953–1954 to raise base to El. + 20 and thus expedite later closure operation. End-dump fill is to be placed in winter of 1956–1957 to effect final closure, and dam will then be carried up to finished elevation of 185 ft.

Main closure at The Dalles without cofferdams

A dam across the Columbia River at The Dalles has been under consideration for 40 years. The site is rather unusual, in that the river bed is at an elevation of 90 to 125 ft below sea level, and the river level is about 80 ft above sea level, creating a minimum water depth of 170 ft. The minimum regulated flow is about 100,000 cfs, and floods of over 1,000,000 cfs may occur. Under such conditions, cofferdams have always been the major problem. In 1933, H.D. No. 103 (Vol. II, page 1574) presented a plan to construct the main dam, a concrete arch, between two temporary arch cofferdams, which in turn were to be built behind a diversion dam composed of 1,000,000 cu yd of large rocks dumped across the channel upstream.

The experience gained in repairing the break in the Bonneville cofferdam stimulated consideration of an earth and rock-fill type of construction for the main dam at The Dalles, and led to the proposal that this structure be built without any cofferdam. Estimates made in 1945 and 1946 resulted in a design for an earth and rock-fill dam built without benefit of cofferdam, using 5-ton and quarry-run rock in the main rock fill and 8-ton rock in the downstream slope.

Experience with concrete tetrahedrons in closing the McNary cofferdam confirmed the practicability of this method. Further model tests at the Bonneville Hydraulic laboratory refined the design in several particulars.

By carefully correlating the placing of closure fill with the height of the floor of the diversion channel, a method has been worked out which permits closure by end-dumping of quarry-run rock up to 1000 lb using larger rock only for the last 100 ft of closure where velocities of 18 fps will be encountered. Total dam length at El. 90 will be about 550 ft.

The Dalles Project (Fig. 3) is now under construction. Rock excavated from the powerhouse foundations and spillway approach channels during 1953–1954 was wasted into the Columbia River at the closure site, thereby raising the base of the closure dam to El. + 20 and greatly reducing the yardage that will be needed for the final closure. About 750,000 cu yd was placed in this manner.

Model studies have indicated that when the end-dump closure fill is 290 ft long, about 62 percent of a theoretical 200,000 cfs flow in the river will be diverted through Units 15 to 22 in the powerhouse substructure. This

is with the approach channel floor at El. 60, and the river surface above at about El. 84. When the fill is 460 ft long, the powerhouse diversion will take care of 93 percent of the flow.

Model studies (1:40 scale) have also shown that if the closure dam is built up uniformly across the channel, no rock larger than quarry run ($^1/_2$-ton) will be required, and maximum velocities will vary from 9 fps when the fill is at El. 50, to 15 fps when it is at El. 70. Thereafter the flow will decrease to zero as the fill accomplishes closure at El. 86.

Material for the upstream blanket will be a natural sand and gravel, which is found within convenient haul distance and has the most desirable combination of imperviousness and shear strength of any naturally occurring materials available. The upstream slope of 1 vertical on 2.3 horizontal is flatter than required for stability but has been adopted to provide adequate thickness of blanket material at the toe of the slope. The downstream slope of 1.0 on 1.5 will have a safety factor of 1.25 against raveling. Seepage loss through the completed structure is estimated to be from 100 to 200 cfs, about $^1/_{10}$ of 1 percent of the flow of the Columbia River.

Diversion and closure will be accomplished during the winter of 1956–1957, raising The Dalles pool to its normal elevation of 160. With the closure fill above El. 86, all the river flow will go through the powerhouse substructure, and the fill will be raised to its permanent elevation of 185. Water in the Big Eddy pool above the dam will be 280 ft deep but the head on the dam will be only 85 ft. A cross section of the closure dam is given in Fig. 4.

The model tests for The Dalles closure dam have been instrumental in reducing the size of stone required and also the amount of large stone required, thereby effecting substantial economies, estimated at over $500,000 as compared with model costs of less than $100,000.

Value of hydraulic model tests

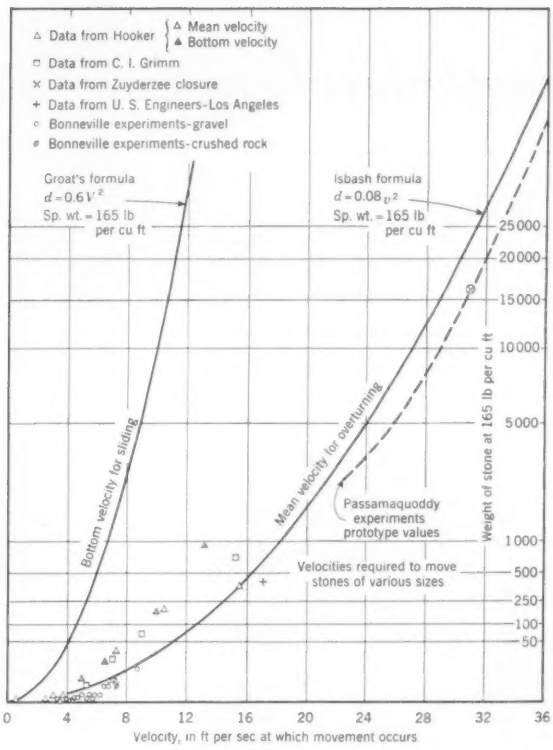

FIG. 5. Curves for stability of stones in flowing water were prepared by U.S. Engineer Office, North Pacific Division, Portland, Ore., to accompany "Report on McNary Cofferdam Closure," dated July 1951.

Few published data are available on the stability of stones in flowing water. In 1938, the North Pacific Division prepared curves showing data by Groat, Isbash, and the Passamaquoddy tests (Fig. 5). The Groat curve is for "sliding" and the Isbash curve for "overturning." These two curves vary widely but still have great value in showing trends. An average between the two would agree quite well with the results of the Bonneville Hydraulic Laboratory tests on a 1:40 scale model.

Model tests are practically indispensable in demonstrating the feasibility of various plans of hydraulic construction. For the closures described in this article, the models demonstrated the distribution of flow between the closure gap and the diversion channels and yielded valuable information on pool elevations, head losses, velocities at various depths and other important data, all at a cost of only a fraction of the savings they made possible. The feasibility of the plans tested was visually demonstrated to interested personnel, including contractors, and frequently improvements in plans were indicated by the tests

Conclusions

Use of large rock in controlling stream flow in a large river has been shown to be economically feasible even where conventional types of cofferdams would not be successful.

Diversion of 200,000 cfs or more can readily be accomplished by cofferdams based on the use of large stones. Such cofferdams can be made relatively impervious by careful selection and placing of an adequate upstream blanket.

Use of cables in placing very large stones in very fast water can materially steepen the downstream slope and effect material savings.

A major dam across the Columbia River is under construction at The Dalles without benefit of cofferdams.

Hydraulic model tests have proved their value many times over in verifying the adequacy and feasibility of construction plans and methods.

Careful selection of diversion-channel elevation with a view to keeping head differential and closure velocities low may pay large dividends by making closure possible with rocks of relatively small size.

These projects have been constructed by leading contractors, but designed, supervised, and operated by the Corps of Engineers, U.S. Army.

Smokeless flare solves propane disposal problem

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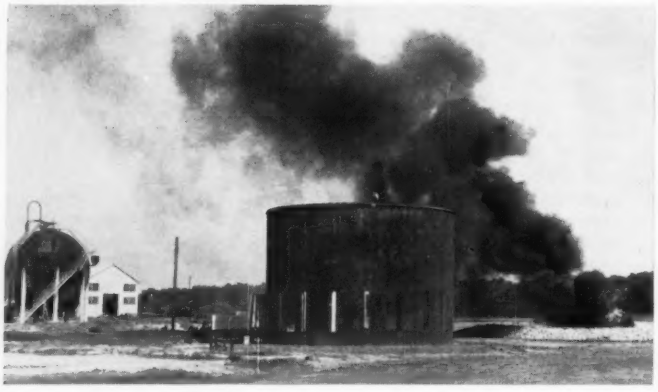


Propane released from processing units in emergencies was formerly burned in unenclosed basin, as shown above, at right, with heavy smoke production. New smokeless flare, in circular, drum-like housing, burns 1,200,000 cu ft per hour in view at right—several times amount being burned above.

A recent installation at the Humble Oil & Refining Company's Baytown, Tex., refinery is designed for the emergency disposal of vaporous propane at a maximum rate of 1,200,000 standard cubic feet per hour (scf per hr). This is accomplished through the use of a liquid knockout system in conjunction with a smokeless ground flare.

The propane lube oil treating unit for which the blowdown system was designed operates with a normal inventory of 5,000 bbl of liquid propane. Because of the nature of this material, it is imperative that it be removed from the unit quickly in case of local fire, to minimize the danger of a general plant disaster.

A simplified schematic flow diagram is shown in Fig. 1. The low-pressure safety valves discharge directly into the ground-flare burner manifold, since no liquid is expected in this stream. The low-pressure liquid blowdown lines and the high-pressure safety valves discharge into the blowdown drum, which operates at approximately 7 psi and minus 30 deg F. On entering this vessel some of the liquid is flashed to vapor, which flows through an overhead line directly to the ground-flare burner manifold. The liquid propane is pumped from the bottom of the blowdown drum to an 8,000-bbl sphere, which operates at 75 psi. Liquid from the high-pressure system and the low-pressure blowdown drum is discharged directly into the sphere. This sphere contains a heat reservoir consisting of 3,000 bbl of kerosene which serves two purposes:

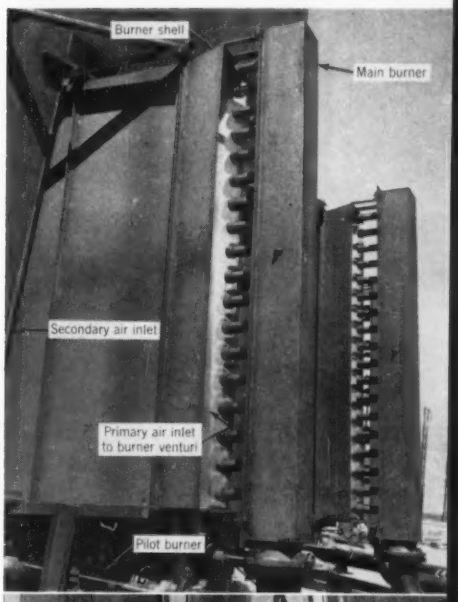
1. It is maintained at 100 deg F by means of an external steam heater, and thus reduces the thermal shock of the propane which, at minus 30 deg F, enters the sphere during blowdowns. This raises the sphere operating temperature and thus has permitted the use of non-stress-relieved carbon steel material in the shell design.
2. The kerosene may be recirculated into the top of the sphere to knock down any foam which may have formed during the blowdown operation.

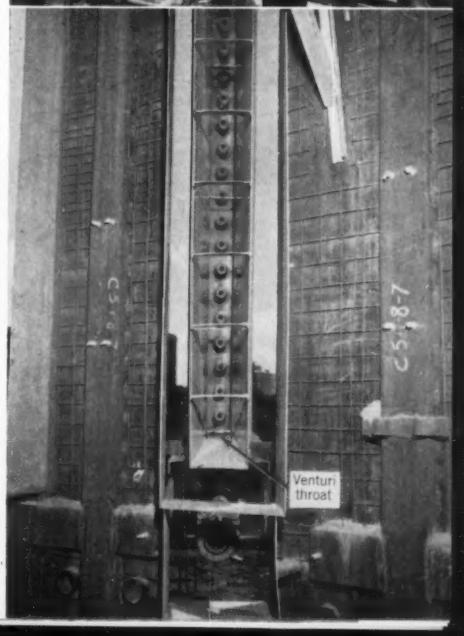
As the propane enters the sphere, some is flashed to vapor which flows via an overhead line and pressure-control valve to the ground-flare burner manifold. The remaining liquid goes into solution with the kerosene and is stored temporarily in this form. The propane is gradually vaporized and released through the overhead line to the ground flare. This temporary storage of the propane permits controlled vaporization and expansion to the low pressures at which the flare burners must operate. This permits the burning time to be prolonged and thus greatly reduces the maximum burning rate of the flare burners.

The blowdown system is so designed that the entire inventory of 5,000 bbl of liquid propane may be released from the unit in one hour in case of emergency. During this release period, approximately 15 percent of the total liquid inventory will flash to vapor and will be burned in the ground flare. The liquid propane remaining in solution with the kerosene in the sphere may be vaporized and flared over a 7-hour period. Thus the entire propane inventory can be removed from the unit in one hour and disposed of by flaring within 8 hours.

One of the chief problems in the design of this release system was to provide an adequate, safe, and practicable flaring device. Complicating factors were: (1) high burning rate required, (2) proximity of public housing area and plant equipment to flare site and consequential radiant heat problems, (3) smoke production problem, (4)

Venturi-shaped smokeless burners are seen from two directions below. Side view of two burners is at top. Lower view, taken from inside of flare housing, shows discharge end of one burner and its pilot below. Note channels welded vertically to inside of $^1/_4$-in.-thick shell, and steel mesh in place, ready for application of gunite lining.



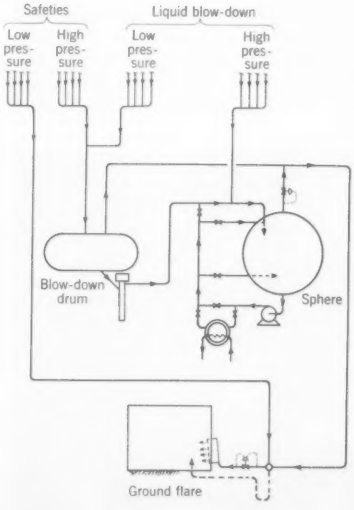


possibility of lubricating oil in the form of liquid or foam being entrained in the gas, and (5) the erratic nature of the release operation.

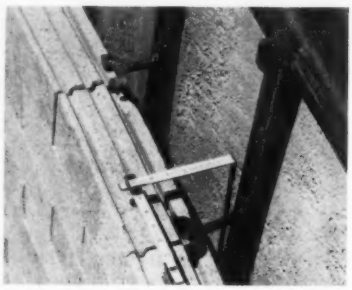
Design details were developed through the combined efforts of Humble's engineering personnel and commercial suppliers of burner and refractory equipment. The new installation, placed in service on August 24, 1955, has been operating satisfactorily ever since.

Several methods of achieving smokeless burning were considered. The use of forced or compressed air, steam, or atomized water was decided against because of the remoteness of these utilities from the flare sites. In addition it was felt that other installations employing these methods of smoke elimination were greatly complicated by the extra control devices required to properly proportion the injected material and the material being burned. It was therefore decided to use air aspirating burners, which were designed and supplied by a commercial burner manufacturing company. The venturi-shaped cross-section of these burners is such that a large quantity of primary air is aspirated, which, in conjunction with secondary induced air, produces com-

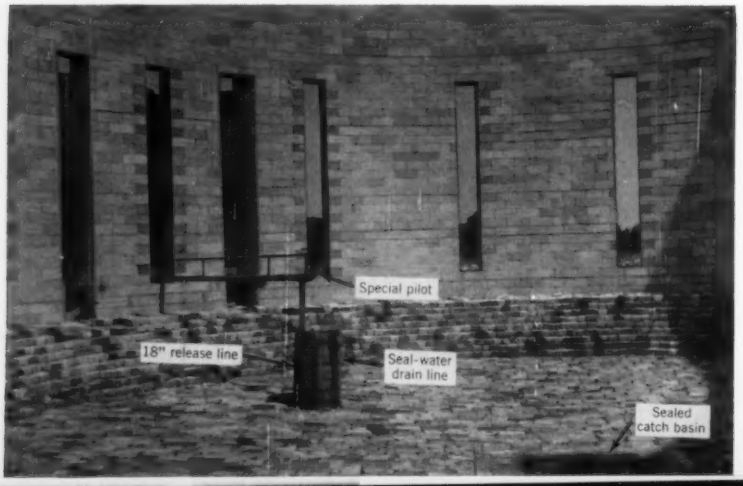
FIG. 1. Simplified schematic flow diagram illustrates propane blowdown system. Three main features are blowdown drum, 12 ft in diameter and 40 ft long; 8,000-bbl intermediate storage and heating sphere; and smokeless ground flare in its drum-like housing.



Gunite lining is being applied to shell of flare housing in view above. Note channels welded to steel shell, and studs welded to channels, to carry tile-support castings. Two views at left and below show how these castings support refractory lining of tile with tongue-and-groove on all four sides of each tile. To avoid damage to shell from high temperatures, space of $3\frac{1}{2}$ in. is left between shell and refractory, and this space is ventilated by 3-in. holes in horizontal rows shown in steel shell.



Completed flare housing is seen from inside. Discharge ends of two burners extend through burner openings in wall. Four of the 19 secondary air slots are shown. Through slot between the two burner openings, special pilot and igniter assembly extends to point directly over 18-in. overpressure release line. Water for the 20-ft seal leg in this line is continually bled into line and drained out through small box and 1-in. line on near side of release line. Overflow discharges into sealed catch basin. Another such basin is provided just outside flare housing so that drain line can be cleaned from outside while system is in service.



plete combustion and consequently a smokeless flame. The high gas velocity maintained at the discharge orifices causes primary air to be aspirated into the inlet end of the burner venturi and mixed with the gas.

Since some burning actually takes place in the burner shell, this is constructed of heat-resisting 430 alloy steel. The burner is attached to the shell of the flare in such a manner that the top is tilted toward the flare through a vertical angle of 5 deg. This permits any liquid or foam that might enter the burner to flow through it and into the flare, where it will be consumed.

The general arrangement of the six-burner pilot assemblies is shown in Fig. 2. The assemblies are mounted in one quadrant of the shell of the flare and aimed in such a manner as to most effectively utilize the available secondary air. The secondary air enters the flare by convection through nineteen air slots 12 in. wide and 8 ft 3 in. high, equally spaced around the lower section of the flare wall.

The high gas velocity required at the burners to produce proper primary air aspiration is maintained by an automatic pressure control system. Gas from the propane blowdown system is discharged into a header of 18-in. diameter near the ground flare (Fig. 2). Six individual butterfly valves control the discharge of the propane gas to the burners. The burners are automatically placed in service one at a time as the gas pressure builds up in the header upstream of the butterfly valves.

When the upstream pressure has reached $4\frac{1}{2}$ psig, the first butterfly valve opens at the command of a snap-acting pilot, placing the first burner in

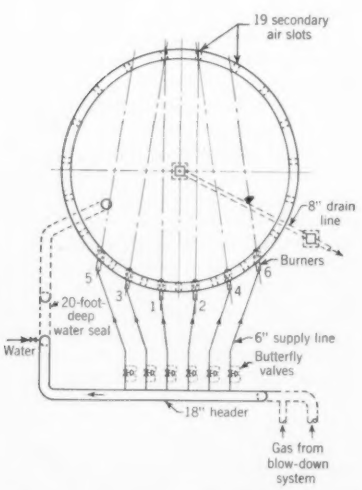


FIG. 2. General arrangement of six-burner pilot assembly is shown in plan.

(Vol. p. 594)

operation. If the upstream pressure drops to $3^1/_2$ psig, the valve is snapped shut by the same pilot. Thus the required gas pressure and velocity are maintained at all times at the burner. If the gas pressure in the header builds up to $4^3/_4$ psig, the second burner is automatically placed in service along with the first and its discharge pressure similarly maintained. Thus the burners are brought into service in sequence, an upstream pressure of $5^3/_4$ psig being required to actuate the last burner during maximum burning conditions.

The minimum header pressure of $3^1/_2$ psig used to actuate the first burner was dictated by the burner design as being the minimum required to aspirate the necessary primary air. The maximum header pressure of $5^3/_4$ psig used to actuate all six burners was considered the maximum allowable back-pressure against which the low-pressure relief valves at the lube-oil treating unit could discharge satisfactorily.

Each main burner is equipped with a commercial pilot burner mounted as shown in a photograph. Each pilot is equipped with a thermocouple which actuates a signal light in the unit control room in case of pilot failure.

As protection against possible failure of the control valves and against exceeding the capacity of the burners, the 18-in. blowdown header is extended into the interior of the flare through a water-seal leg or U-bend 20 ft deep. Overpressuring of the header causes the water seal to blow out and the gas to be discharged directly into the flare, where it is ignited by a special pilot. Under these rare conditions smokeless burning will not be achieved.

Severe operating conditions greatly complicated the structural design of the flare. High rates of heat production (2,300 to 2,500 Btu per cu ft of propane gas), intermittent operation, the possibility of liquid or foam, exposure to weather, and heat radiation and smoke production problems all contributed to these complications. It was considered essential that some type of rigid structure be provided to support the burner equipment. A completely enclosed burning space was indicated because of the desirability of restricting horizontal radiation of heat in all directions. The dimensions of the enclosing drum-like structure (45 ft in diameter and 30 ft high) were considered a minimum to provide proper mixing and combustion space, and the required chimney effect for the induction of secondary air.

The foundation consists of a circular reinforced concrete grade beam, 18 in. deep and 30 in. wide, supported on 16 drilled footings which rest on clay. On this grade beam is supported the cylindrical refractory wall of the flare housing. The outer shell of carbon steel $^1/_4$ in. thick serves as a fairly rigid support for mounting the burners and the suspended refractory lining. To provide additional rigidity for the shell, a wind girt of 5 x 5 x $^3/_4$-in. wide-flange angle was installed around the top on the outside, and 6-in. channels were welded vertically to the inside surface of the shell. Studs of 18-8 chrome-nickel steel were welded to the backs of these channels and the tile support castings attached thereto.

On the inside of the metal shell a $1^1/_2$-in.-thick, corrosion-resistant gunite lining was applied to 3-in. x 3-in. wire reinforcing mesh. The refractory, which is of first quality fire clay, was furnished along with the support castings by a commercial refractory wall manufacturer. The refractory is made up of tile $4^1/_2$ in. thick, $4^1/_2$ in. high, and $12^1/_2$ in. long, with double tongue and groove all around. The tiles were installed without mortar and were placed with vertical gaps $^1/_{32}$ in. wide between ends of adjacent tiles at the hot face to allow for circumferential expansion on heating.

Straight faced tile was used in preference to curved tile in the interest of simplicity and standardization. The wall is of large enough radius to accommodate the straight tile with only a slight spreading of the vertical joints at the cold face. It is estimated that gas temperatures in the flare may be as high as 2500 deg F. However, a design temperature of 1,800 deg F maximum was assumed at the hot face because of the cooling effect of secondary air. This temperature would be sufficient to cause rapid deterioration of the steel shell and its gunite lining if in direct contact with the tile. Therefore, an air space $3^1/_2$ in. wide was provided between the tile and the gunite lining. To provide cooling air for this space, horizontal rows of holes of 3-in. diameter are provided in the outer shell and gunite lining. Both the burner openings and the secondary air slots are lined with stainless steel $^1/_8$ in. thick, type 430.

The entire floor of the flare housing is lined with a layer of reclaimed fire brick laid without mortar, as shown in a photograph. This serves to protect the soil against deterioration produced by high temperatures and subsequent erosion during heavy rains. Reclaimed fire brick was placed, without mortar, around the bottom of the wall, to a depth and width of approximately 24 in. This protects the concrete grade beam from high temperatures. A freeboard of 24 in. was maintained in the flare housing, below the lowest opening in the wall, to retain any foam or liquid which might be inadvertently discharged from the blowdown system. Some of this liquid could possibly be discharged, unburned, into the sewer system, but it is felt that most would be consumed within the flare.

After the release system was placed in service in August 1955, a full-scale test was made on the ground flare. All six of the burners were operated separately and simultaneously with no smoke production.

At one time during the test, pressure in the header became sufficient to blow out the water seal in the 18-in. overpressure release line, causing the gas to bypass the burners. The secondary air was effective in reducing smoke but more was produced of course than with normal operation. The overpressuring of the system during the test was primarily due to the sluggish operation of the butterfly valves feeding the burners. After the test, pneumatic boosters were installed on the valve controllers, and these reduced the opening time of the valves to about one second, with the result that pressures have since been kept sufficiently low in the 18-in. header to maintain the water seal in the overpressure release line.

At one time since the release system was placed in service, a unit operational upset caused the flare to operate continuously for approximately two hours at half the maximum burning rate (three burners operating). During this time heat was released at the rate of approximately $1^1/_2$ billion Btu per hour, yet it was possible for me to approach to within a few feet of the burner shell without undue discomfort from radiant heat. During this period of operation, special notice was made of noise produced by the aspiration of primary air into the burners. Within 50 ft of the flare, noise was such that conversation was difficult and frequencies were in such a range as to produce auditory discomfort within a short time. However, at distances greater than 50 ft little discomfort was experienced, and at a quarter of a mile the noise was hardly noticeable. Experience has shown that there is normally only intermittent operation of one burner, and that under such conditions noise is not at a disagreeable level.

The designers feel that the expenditure for this release system is justified on three counts: (1) safer unit operation, (2) a minimum of mechanical maintenance of the system, and (3) improved public relations resulting from smokeless flaring and controlled heat radiation.

The accompanying photographs are by photographers of Humble's Engineering Division.

Affiliate Membership in EJC evaluated

E. PAUL LANGE, M. AIME, Secretary, Engineers Joint Council, New York, N.Y.

This article has been prepared in answer to many requests for information concerning the role of Engineers Joint Council in the engineering profession, particularly the role of its Affiliate Member societies.

The profession is represented by engineering societies formed of individual members having a common technical interest. To facilitate communication between members, local sections or chapters of national societies have been formed to operate in communities or geographical areas. In addition, there are many local or regional societies composed of members from the several branches of engineering.

The technical phase of the profession has been developed to a high degree by each society, but the impact of the profession on the public by the individual, his local section, or national society requires a coordinated effort by all the segments of the profession. Engineers Joint Council provides the medium for this effort.

The history of EJC was carefully documented by T. A. Marshall, Jr., in CIVIL ENGINEERING articles (June 1954, page 364, and July 1954, page 444), entitled "EJC and the Unity of the Engineering Profession." In its present form, EJC was created from Engineers Joint Conference, composed of the Presidents and Secretaries of five societies. In 1945, the Council structure was reorganized, and its present constitution adopted, representation being drawn from the boards of the constituent societies.

That engineering is a profession is generally accepted. Unity within a segment of the profession is an accomplished fact, as evidenced by any of the national engineering societies, composed of members with similar technical interests. Unity within the profession is a goal yet to be achieved.

As the member societies in special fields of engineering serve their members in their specific areas, so EJC enables the individual engineer to make the greatest possible contribution to the national welfare and economy by promoting public recognition of engineers.

Engineers Joint Council represents the individual engineer as much as it does the engineering societies which make up its membership. EJC's constitution provides for management by groups of officers, directors, and committeemen whose tenure is as brief as is compatible with efficient functioning. For these reasons, domination by any one group or clique is precluded and representative policy assured.

EJC was established in spite of the difficulties inherent in the organization of federations. Strong national societies in the several fields of engineering have developed over the years. The majority of engineers, unlike persons in other professions, are employees rather than individual entrepreneurs. As a result of the character of their employment, therefore, there exist wide differences in individual attitudes toward the profession and toward the public policy concerning engineering. The constitution and bylaws, under which the Council functions, recognize these facts. The effectiveness of EJC in reflecting a majority opinion of the profession has already been successfully demonstrated in a number of areas.

The mechanics of accomplishing the objectives of EJC, which are continually subject to change as conditions demand, is based on a democratic organization set up by EJC's constitution.

The EJC board of directors is composed of representatives, who are individually members of the boards of the constituent societies they represent, and alternates who may or may not be members of that society's board, at the option of the society. This option permits wider geographical distribution of society representation. The EJC Board meets regularly to consider developments affecting the engineer and the engineering profession as a whole. If the situation calls for a group to investigate and report, the Board appoints such a committee. The committee, in turn, reports back to the Board, which accepts or rejects the findings of the committee and takes action, on behalf of the societies, in accordance with the information available. See Fig. 1 for a diagrammatic representation of the organization. A president and vice-president are elected annually from among those who are currently representing, or have previously represented, a constituent society. A secretary and treasurer are appointed to serve at the pleasure of the board. To facilitate operations of Council, there is also an executive committee which acts on behalf of the board.

Neither the boards of the constituent societies nor their delegates on EJC react to all major problems in the same way. Various segments of the profession view certain matters differently. A function of EJC is to make pronouncements reflecting the majority opinion of the profession. EJC has been successful in this, and generally can and does act promptly and positively when impelling situations arise.

Subsequent to the adoption of the constitution, a Committee on Unity in the Profession was established. On its recommendation an Exploratory Group, consisting of representatives of fifteen societies, studied the EJC structure. Included in their recommendations were modifications, which would permit enlargement of the Council through the addition of Associate and Affiliate Member societies.

Associate and Affiliate societies

The provisions for Associate and Affiliate society memberships in EJC, incorporated in the Constitution in 1954, and implemented with definitive By-laws in 1955, were based on the two-year Exploratory Committee study.

Associate Member societies are national in the activity and technical interest of their members, differing only in size from the larger Constituent societies. To ensure adequate breadth of membership interest, the arbitrary figure of 5,000 members was selected as minimum for Constituent membership. National societies, meeting all other requirements, are accorded Associate status until their membership has passed the 5,000 figure.

The Affiliate Member societies are composed of either of two types of organizations, or even a combination of both. One is the local or independent regional society, organized and operating for the benefit of the engineers in an area. The other, of greater importance to readers of this article, is the federation of engineering societies, or local sections or chapters of such societies.

Since all individuals trained in the

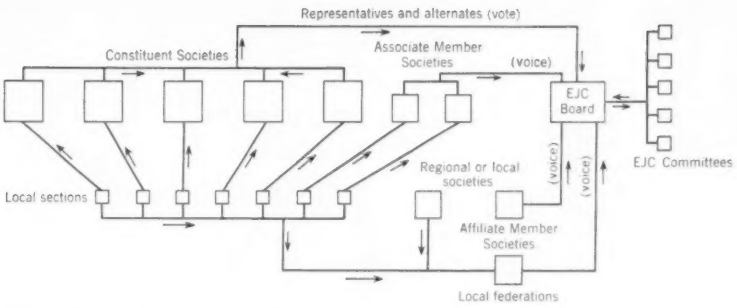


Fig. 1. Organization of Engineers Joint Council is shown graphically. Number of squares is illustrative only.

engineering profession are engineers first and specialists second, there has developed the need for a common medium of expression. The federation of local sections and/or regional societies provides a forum for specialists with the one common interest, the profession of engineering, to become associated in affairs of public interest.

Engineers, as professional persons, are obligated to devote part of their time and effort to matters affecting public interest. In order to help the engineer obtain proper public recognition and professional status, the public must know of him both as an individual and as a member of a group. Many community problems have an engineering aspect, which requires the advice and services of public-spirited individuals within the profession. The federation provides the medium through which the public may call on the individual or the group for the service and help that it needs.

At national level, EJC provides the connecting link between the national and the local societies or federations, which find the problems in their communities are similar to those in other communities and thus look to EJC to aid in finding an adequate solution.

Technical development of the individual is essential, and is the main function of his local section, but the value and benefits of such development can be of material assistance to the public only if made available to it by organized group action. Local federations act as the catalyst for the individual engineer in his relations with the public on the level with which he is most conversant, that of his community or state. This procedure is being followed at national level through the assignment of more and more problems of public interest to EJC, with the national societies continuing their traditional role of promoting development of the profession in their respective fields. A similar separation at local level permits flexibility in the activities of a local group without posing the legal problem of the right to take part in local, state, or regional legislative matters.

Positive action which can be taken by national societies on legislative matters, is limited by the strict regulations of the Bureau of Internal Revenue. All member societies of EJC have requested and been granted classification as non-profit organizations under the Internal Revenue Code Section 501(*c*)(3). This section permits individuals to make gifts, bequests, or donations to the societies which are tax free to the donor. However, if the societies should devote a substantial part of their activities to attempting to influence legislation by propaganda or otherwise, this privilege would be rescinded and the other advantages of this classification would be lost.

Although EJC is also a non-profit organization, it is classified under Section 501(*c*)(6), which is defined in the Code as a "business league." Gifts or bequests made to a business league are taxable to the donor. The activities of a business league may be directed to the improvement of business or professional interests for the organization's benefit.

The line of demarcation between activity in the legislative field and lobbying is not clear cut. However, from discussions with the Bureau, it would appear that activity in the legislative field refers to interest in the *policy* inherent in the legislation, while lobbying is construed as positive action taken on a specific item of legislation. EJC has a long-established and well-defined interest in policy contained in legislation affecting the engineering aspects of the development of the country, but in no instance has it taken a positive stand on a specific item of legislation. Local federations, state or regional, if formed and operated along the same pattern as EJC, would probably be permitted the same latitude of action within their fields of interest. Each individual case must be examined on its own merit.

A federation of local engineering groups could be a simple answer, since a federation is in itself an entity. A federation is composed of duly elected or appointed representatives from each of the local groups. The policies of the federation are an accurate reflection of the policies of the member engineering groups. Each local section, chapter, or independent society contributes a nominal amount for the financial support of the federation. Declarations of policy are the right of the federation, rather than of its individual components, for the federation is the reflection of unity and strength. The validity of the axiom, "In unity there is strength," must be apparent.

The relation of EJC to this picture is simple. A local federation enhances its effectiveness by becoming an Affiliate Member Society of EJC. A national policy has no value unless it has the support of the local members; the individual engineer cannot know accurately what the national policy is and how it may affect the community in which he lives except through group action.

The question has often been raised concerning the advantages of dual representation in EJC. One comes through regular membership in a national society with the society board representatives speaking for their members at the EJC Board. The other comes through an observer from a federation, which has a voice at all meetings of the EJC board and a vote at the annual meeting of the board. Each serves a specific purpose. The national society board member reflects the considered opinion of the majority of the members at the national level, while the observer from the federation brings to the EJC board the specific policy problems of the area which he represents. The opinions of each are essential to the establishment of satisfactory basic policy that will be of value and benefit to the profession and the public which we serve.

Science is continuing to provide engineering with ever-expanding vistas. The utilization of new metals, the applications of nuclear phenomena, the harnessing of the vast store of solar energy, electronic and mechanical developments in automation, increasingly invest the engineering profession with social as well as technological responsibilities. The activities of this influential and representative federation of engineering groups striving to bring to bear the weight of the entire profession on these problems should stir the imagination and enlist the support of every engineer.

(Abstracted from an address by the author before the Pacific Southwest Council of Local Sections of ASCE, in Pasadena, Calif., April 19, 1956.)

TOWER for radiation unusual re

GIBSON MORRIS, Chief Engineer, Engineering Department, Oak Ridge National

A unique type of tower has been completed at the Oak Ridge National Laboratory. To call this tower unusual is perhaps misleading. Actually there is nothing really unusual or novel in the design principles on which it is based. In fact, many engineers have satisfactorily solved design problems of a much more formidable nature. However, it cannot be denied that the resulting structure is unique, and was constructed to meet a set of requirements rarely encountered by engineers.

As we enter the atomic era, and as engineers in all fields become more actively engaged in designing the facilities required for the development of atomic energy, we must become acquainted with the new conditions that rule there. For this reason I believe that the unique requirements governing the design of this tower will be of interest, as such requirements are not met with in normal industrial installations.

Our business at Oak Ridge National Laboratory is that of research and development, and one of the prominent research programs throughout the entire atomic energy program is shielding from the radiant energy produced in the operation of nuclear reactors. Without attempting to explore or define the various types of radiation, I will simply use the term radiation in an all-inclusive sense. The physicists can pretty well predict the general relationships to be expected. However, the specific effects of different media can only be accurately determined by actual physical measurement.

Since radiation can be absorbed or deflected, or can penetrate, depending on the nature of the object in its path, it was desired to demonstrate on a large scale what would happen if no mass of material was placed in the path of the radiation, and to verify the theoretical assumptions that had been made for this situation. The ideal facility for such an experiment obviously would be some form of "sky hook" which, in effect, would place the source of the radiation at some point in the air with no object of any sort close to it. Although for a long time we have had occasion to make use of the term "sky hook," no one (unfortunately) has been able to devise one. It became our job to do what we could to suspend a radiation source in the atmosphere — sufficiently removed from any mass, such as the ground and a supporting structure, so that it would be possible to evaluate the behavior of the radiation when surrounded by nothing but air.

Weight of radiation source a factor

The problem becomes somewhat complicated when the radiation source weighs up to 55 tons, and the necessary instrumentation to accompany the source weighs up to 30 tons additional. To further complicate the problem, the radiation source and the instrument receiver are required to be so suspended that they can be moved in two planes with respect to each other. First our theoretical physicists indicated the height above ground at which the radiation source would have to be to escape the adverse effects of the ground itself. They also specified what maximum mass could be tolerated at a given distance from the radiation source. This, then, was the problem presented to the Engineering Department at the laboratory.

Several ideas were examined, one being the use of a canyon of sufficient depth and width to permit the support of such a source in space. This idea was discarded because, although it might eliminate the cost of erecting a structure, there would still be the costs of buying the canyon, building a road, housing operating personnel, etc., and these costs would be prohibitive.

The services of the firm of Tippetts, Abbett, McCarthy & Stratton, of New York, N. Y., were engaged to design a structure to support the radiation source and the instrument receiver. Considerable time was spent working very closely with this firm, exploring ideas, and developing the basic criteria which the structure would have to meet. Some four or five design proposals were examined before agreement was reached on the most appropriate one (Fig. 1).

In our efforts to provide such a facility as I have described, we were very conscious of the economics involved. If the amount of money to be spent is not a factor, a design problem can sometimes be quite simple. However, when the aim is to provide a facility that will produce the desired results at the lowest possible cost, then the design problem to be solved becomes more severe.

The problem was finally resolved after a series of preliminary calculations.

testing meets quirements

Laboratory, Oak Ridge, Tenn.

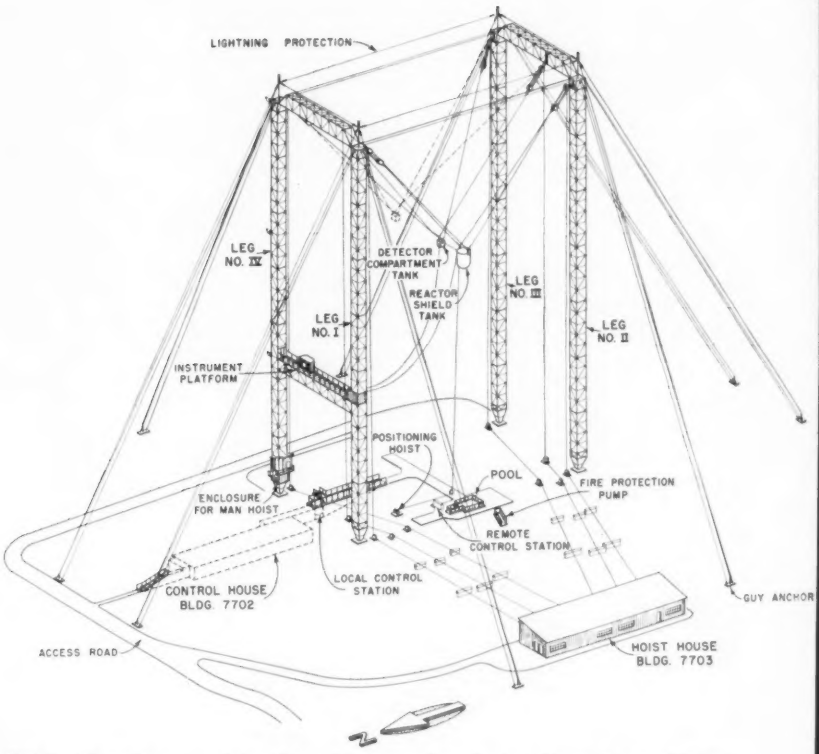


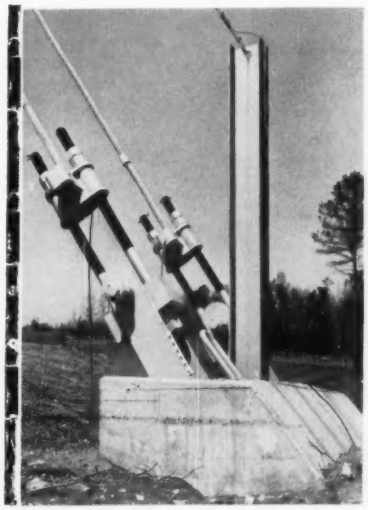
FIG. 1. Three-dimensional view shows structure and numbering of tower legs used in text.

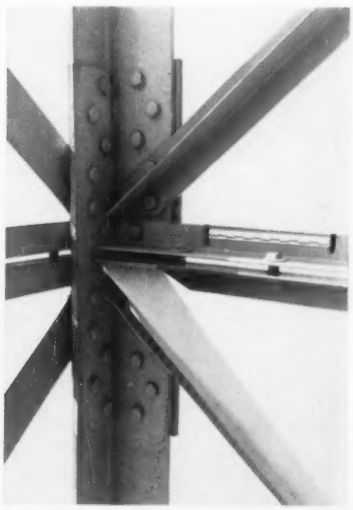
The following is the basic design premise under which we proceeded:

Two individual and separate loads are to be lifted vertically a distance of 200 ft above the ground, these two separate loads to consist of one 55-ton load and one 30-ton load. The 55-ton load is to be provided with hoists for vertical travel only, and the 30-ton load with hoists for both vertical and horizontal travel—the horizontal travel to allow for varying the distance between the two loads from 35 to 100 ft on a horizontal plane.

In addition, the design is to provide for some future installation of an additional 40-ton load, to be located at the center of the structure. A minimum of mass in the structure is to be attained. The amount of the mass must have a direct relationship to its distance from the radiation source.

Typical tower details are: (left) leg base, with a hoist sheave at lower left; (center) guy anchor, including vertical beam which provides anchorage for copper lightning protection cable; (right) field connection in leg section, with 8 x 8-in. angles as main members.





To make this determination, then, an economic evaluation of the distance versus the mass of the structure had to be made. It was determined that the most attractive combination was one in which a maximum of 400 lb of mass per lineal foot of each leg of the structure would satisfy the conditions. At this stage we limited the movements of the suspended loads under a 20-mph wind to a maximum of 6 in.

There followed the preparation of general designs and cost comparisons which indicated that, of the semi-rigid structures investigated, one with longitudinal cable ties and pinned transverse trusses in the end bents offered the greatest opportunity for basic economy consistent with structural stability, reasonable erection methods, and positioning of the loads by the use of conventional hoisting and rigging equipment. The structure was developed, then, on the basic concepts that there would be no structural framing, and no members except lifting and guy cables, within a distance of 100 ft of either the 55-ton or the 30-ton load; and that support for the two loads would be open-ended, that is, there would be no structural framing beyond either load or between the two loads.

Final design determined

The structure chosen, then, would consist of two similar steel towers placed 200 ft apart and tied together at the top with prestressed steel guy cables of 2-in. diameter. Each tower would consist of two legs 100 ft apart. Each tower leg would be a lattice column 9 ft square and 315 ft high. The two legs of each tower would be joined at the top with a lattice truss 9 ft square and 100 ft long, so as to space the columns 100 ft apart.

This structure would be braced with 16 guy cables attached to the top corners of each tower and extending diagonally to 8 guy anchors. The foundation for each of the four legs (two for each tower) would be of reinforced monolithic concrete, 12 ft square and 3 ft thick, supporting piers 6 ft square and 3 ft high. Embedded in each pier would be eight anchor bolts of 1-in. diameter and one anchor pin of 3-in. diameter. The 8 guy anchors would be rectangular blocks of reinforced concrete, 20 X 12 X 8 ft thick with two H-beams with 10-in. flanges embedded in the block for the guy cable ties.

The guyed and braced design was then developed in complete detail to establish its essential validity, economy, and feasibility. The 2-in. cables would be prestressed 40,000 and 76,000 lb in horizontal ties and inclined guys respectively.

Live-load conditions established

For the structural design, the following basic live-load conditions were established:

Case I. Dead load + live load + 20 percent impact on the 55-, 30-, and 40-ton loads.

Case II. Dead load + 30 psf; wind on $1^1/_2$ times the projected area of members, with no suspended loads.

Case III. Dead + live load + 20 psf; wind on $1^1/_2$ times the projected area of members and exposed areas of suspended loads.

Case IV. Dead load + live load + 0.05 seismic force.

Case V. Dead load + live load + 20 percent impact + 2 psf for wind. This case was designated as the original operating condition. Later it was desired to operate with winds up to 50 mph with 10-ton and 47-ton loads respectively. An investigation was then made by Prof. A. T. Granger, M. ASCE, Head of the Civil Engineering Department at the University of Tennessee, which indicated the resulting stress to be within the allowable limits of the structure.

As is usual in the case of tall structures, the wind load was the governing factor in the design, as in Case II above. The contributions to the total stress in the steel legs were approximately as follows: wind, 65 percent; dead load, 5 percent; prestressing, 20 percent; and live load, 10 percent. AISC allowable stress values were used in the design of all the steel members. This allowed a design load of 20,000 psi for tension members for Cases I and V, and 27,000 psi for Cases II, III, and IV. To eliminate essentially all tower movement resulting from wind load and hoisting load, it was decided to prestress the cables to 76,000 lb each. To remove the initial stretch and stabilize the modulus of elasticity as well as to determine the modulus, the cables were cut to approximate length at the factory, and prestressed to 76,000 lb each. After the initial stretch had been removed, metal tabs were placed on the cables so that the field forces could measure the distance between tabs and thus achieve correct tension.

In the preliminary designs, the use of A94 structural silicon steel was considered for the main members, in which the unit stress was of course a vital consideration. While the use of this steel might have reduced the mass of the structure somewhat, the doubt as to any real economy in the cost of fabrication and material, led to the final decision to use conventional A7 carbon steel. Therefore welded construction was chosen for the legs, trusses, and bracing members of the recommended design, the field connections between sections of legs, and between legs and trusses, etc., to be made with high-strength bolts. For purposes of shipping and erection, the tower legs were fabricated in sections (9 x 9 x 45 ft) that could be conveniently accommodated in a 50-ft open freight car or on a truck trailer.

To facilitate handling, loading, and erection, the 9-ft-square tower legs were shop fabricated in sections 45 ft long, and the three 100-ft-long trusses (one an instrument platform having no structural purpose) were each fabricated in two sections. Most of these sections were transported directly to the site by motor truck and trailer.

The four tower legs were erected in pairs (legs II and III together and then legs I and IV). After the two lower sections had been erected, a twin-boom derrick was mounted at the top of each leg. The derrick and a multiple-drum hoist, anchored near the base of each leg, were used to hoist the next 45-ft section of each tower leg into position. As each succeeding section was secured in place with field erection bolts, the erection derricks were hoisted to the top of the structure by means of rigging powered by a second multiple-drum hoist. Temporary guy cables to support the legs were moved up as each section was erected. When the derricks reached the top of their respective pair of legs, they hoisted into place the truss that connected this pair of legs, which had previously been assembled on the ground directly below its final position.

An interesting problem arose during the pretensioning of the guy cables. In the course of plumbing the legs, one pair of guy cables was pretensioned to the specified amount, as determined by measuring the distance between the tabs. Theoretically, then, the opposing set of cables should have been under the same tension. However, when the distance between the tabs was measured and the stress calulated, this stress appeared to be about half that carried by the opposing pair of cables. No explanation for this phenomenon was ever presented, but by adjusting and checking the tension from the computed period of the cables, equalization was obtained.

This then is a brief description of the design and construction of a tower that has been labeled unusual, although in my opinion it actually is unusual largely because of its purpose in the field of radiation research.

(This article has been prepared from the paper originally presented by Mr. Morris at the Knoxville Convention, before the Structural Division session presided over by Armour T. Granger, Chairman of the Division's Session Programs Committee.)

Finding the interval between dates

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The day is a basic time measuring unit and is universally used. Our everyday calendar, while adequate for most purposes, becomes troublesome when the day interval between dates is desired. A number of methods to eliminate the use of weeks, months, etc., have been used. Probably one of the simplest of these is the use of tables based on the Julian Day number.

The Julian Day number is widely used in astronomy. Its history is not essential to its use but may be traced by anyone so inclined. (See R.N. Mayall, "Betwixt and Between Dates," *The Scientific Monthly*, Vol. 82, 1956, pp. 210–211.) Briefly it is based on the suggestion by Joseph Scaliger in 1582 that the common multiple of three cycles —Solar, Metonic and Roman indiction— or 7,980 years, be used as a universal chronological measurement. Scaliger established 1 January 4713 B.C. as the beginning of his Julian Period, which will end in 3267 A.D. The first day of January 1956 was Julian Day 2,435,474.

In tables based on the Julian Day number, each day is given a number which represents its numerical succession since the beginning of the Julian Period. Then to find the interval in days between dates it is only necessary to subtract the corresponding Julian Day numbers. Conversely, knowing the interval and desiring the dates, addition and subtraction using Julian Day numbers will furnish the answer.

Table I shows part of a 100-year table from the article by Mr. Mayall previously referred to. Suppose that elevations were determined on a settling structure such as a bridge abutment on 13 May 1956 and again on 5 March 1957 and it is desired to plot this on a time-settlement curve. Using Table I, and omitting the first digit, the following is obtained:

5 March 1957	= J.D. 5903
13 May 1956	= J.D. 5607
Number of days	= 296

Use of the Julian Day number is not restricted to any field of work. In concrete testing it is sometimes desired to set up a schedule of breaks over a period ranging from months to years. Use of the Julian Day number might simplify scheduling. If, for example, an interval of 180 days is desired after 17 October 1958:

17 October 1958	= J.D. 6494
Interval	= 180
End of interval	= J.D. 6674
April 0, 1959	= J.D. 6659

Interval ends April 15, 1959

The Julian Day number may be derived from several publications. The annual calender of the American Association of Variable Star Observers known as the AAVSO Julian Day Calendar (United Scientific Co., 204 Milk St., Boston 9, Mass.) has an international distribution. The annual *American Ephemeris and Nautical Almanac* (Superintendent of Documents, Washington 25, D.C.) contains a table from which any Julian Day number between 4713 B.C. and 2019 A.D. can be derived. Probably the simplest form is the 100-year "work card" covering the period between A.D. 1900 and 2000. These work cards, similar in form to Table I, are available at reasonable cost (Planning and Research Associates, 45 Bromfield St., Boston 8, Mass.)

TABLE I. Part of 100-year "work card" showing Julian Day number for zero day of each month, 1956–1966

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1956	35,473	35,504	35,533	35,564	35,594	35,625	35,655	35,686	35,717	35,747	35,778	35,808
1957	35,839	35,870	35,898	35,929	35,959	35,990	36,020	36,051	36,082	36,112	36,143	36,173
1958	36,204	36,235	36,263	36,294	36,324	36,355	36,385	36,416	36,447	36,477	36,508	36,538
1959	36,569	36,600	36,628	36,659	36,689	36,720	36,750	36,781	36,812	36,842	36,873	36,903
1960	36,934	36,965	36,994	37,025	37,055	37,086	37,116	37,147	37,178	37,208	37,239	37,269
1961	37,300	37,331	37,359	37,390	37,420	37,451	37,481	37,512	37,543	37,573	37,604	37,634
1962	37,665	37,696	37,724	37,755	37,785	37,816	37,846	37,877	37 908	37,938	37,969	37,999
1963	38,030	38,061	38,089	38,120	38,150	38,181	38,211	38,242	38,273	38,303	38,334	38,364
1964	38,395	38,426	38,455	38,486	38,516	38,547	38,577	38,608	38,639	38,669	38,700	38,730
1965	38,761	38,792	38,820	38,851	38,881	38,912	38,942	38,973	39,004	39,034	39,065	39,095

Two-way slab design simplified by tabulation

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Design of two-way reinforced concrete slabs is in itself rather an easy problem but keeping the different coefficients, moments, and spacings of steel straight can become rather confusing. By using the form shown in Table I, it is possible to work out an entire floor system rapidly with a minimum of confusion.

A table is set up to include each different panel in the floor system. Using the ratio of short span to long span and proper edge conditions, a coefficient for each support and mid-panel is interpolated from the coefficients given in the ACI Code for two-way slabs. Using the formula, $M = CwL_s^2$, it is possible to select the maximum moment in the floor system with a minimum number of calculations. The term w includes live and dead load. Therefore, a slab thickness should be assumed. The term L_s is the short span of the panel.

After the maximum moment is determined, the effective depth d is calculated from $d = \sqrt{M/K}$. The slab thickness can be revised and the correct value of w obtained. Since the steel for the positive moment (long span of each panel) rests on top of the short-span steel, the d for this steel should be checked using the maximum positive moment (long span) for the entire floor system.

It is now possible to completely fill out the table, determining the area of steel required at mid-span and supports in each panel from $A_s = \dfrac{M}{fjd}$. The effective depth is equal to the total slab thickness minus 1 in. for all points except for the positive steel (long span). Here d is the total slab thickness minus 1 in., minus the diameter of the steel reinforcing. Steel at the supports is furnished by bending up two-thirds of the steel, allowing one-third to remain in the bottom of the slab. The outer strip in each panel requires two-thirds of the steel required in the middle strip. This is also tabulated in the same manner.

When the tables are completed, it is possible to see what steel is required in any area and how it is to be furnished. A sample design is given below to illustrate the use of Table I.

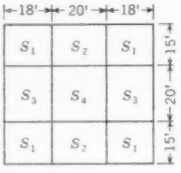

Fig. 1. Sample floor system of two-way reinforced concrete slab is designed by use of Table I.

The 56 × 50-ft building shown in Fig. 1 is divided into panels as shown. Design the complete floor slab. Assume $f_c = 1{,}200$ psi, $f_s = 18{,}000$ psi. Live load = 250 psf. Use No. 4 bars for reinforcing.

Solution: $J = 0.867$
$k = 0.400$
$K = 208$

Tabulate coefficients and moments as shown in Table I.

Assuming a trial slab of 6-in. thickness, $W = 250 + 75 = 325$ psf. Check the effective depth for maximum negative and positive moment.

$$d = \sqrt{\frac{M}{K \times 12}} = \sqrt{\frac{60{,}600}{208 \times 12}} = 4.94 \text{ in.}$$

Use $d = 5$ in.

Total slab depth = 6 in., as assumed.

$$d = \sqrt{\frac{39{,}200}{208 \times 12}} = 3.96 \text{ in. required.}$$

$d = 4.5$ in., furnished

The remaining calculations are made by slide rule and set down in tabular form, as shown in Table I.

TABLE I. Two-way slab design—ACI Code

Panel	L_s/L_l	Data	Formula	Pos. Mom. (Center)		Negative Mom. (Cont. Edge)				Neg. Mom. (Discont. Edge)	
				Short Span	Long Span	Short Span		Long Span		Short Span	Long Span
Center thirds:											
S_1	0.833										
S_2	0.750	Coef. C	ACI tables	0.046	0.037	0.062		0.049		0.031	0.025
S_3	0.900			0.044	0.031	0.058		0.041		0.029	...
S_4	1.000			0.036	0.031	0.048		0.041		0.024	...
				0.025	0.025	0.033		0.033		...	...
S_1		Moment, in.-lb	$M = CwL_s^2 \times 12$	40,400	32,500	54,500		43,000		27,200	22,000
S_2				38,600	27,200	50,900		36,000		25,400	...
S_3				45,500	39,200	60,600		51,800		30,300	...
S_4				39,000	39,000	51,500		51,500		...	...
S_1				0.517	0.462	S_1-S_3	S_2-S_4	S_1-S_2	S_2-S_4	0.348	0.282
S_2		A_s req'd, sq. in.	$A_s = \dfrac{M}{f_s j d}$	0.495	0.387					0.326	...
S_3				0.583	0.558	0.699	0.660	0.551	0.776	0.388	...
S_4				0.500	0.555					...	...
S_1				4½	5	⅔ × .52	⅔ × .52	⅔ × .47	⅔ × .59	⅔ × .52	⅔ × .47
S_2		Spacing, in.		4½	6					⅔ × .52	...
S_3				4	4	⅔ × .59	⅔ × .52	⅔ × .39	⅔ × .59	⅔ × .59	...
S_4				4½	4					...	...
S_1				0.52	0.47					0.35	0.31
S_2		A_s furn., sq. in.		0.52	0.39	0.74	0.69	0.57	0.79	0.35	...
S_3				0.59	0.59					0.39	...
S_4				0.52	0.59					...	...
Outer thirds:											
S_1		A_s req'd, sq. in.	⅔ A_s req'd, center strip	0.345	0.308					0.232	0.188
S_2				0.330	0.258	0.465	0.440	0.367	0.518	0.217	...
S_3				0.388	0.372					0.258	...
S_4				0.333	0.370					...	...
S_1				6½	7½					⅔ × .36	⅔ × .31
S_2		Spacing, in.		7	9	⅔ × .36	⅔ × .34	⅔ × .31	⅔ × .39	⅔ × .34	...
S_3				6	6					⅔ × .39	...
S_4				7	6	⅔ × .39	⅔ × .34	⅔ × .26	⅔ × .39	...	...
S_1				0.36	0.31					0.24	0.21
S_2		A_s furn., sq. in.		0.34	0.26	0.50	0.45	0.38	0.52	0.23	...
S_3				0.39	0.39					0.26	...
S_4				0.34	0.39					...	...

Metal lining fastened with power-driven studs

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At the Atomic Energy Commission's Savannah River Plant, process specifications required the lining (sheathing) of certain concrete walls and floors with stainless-steel sheets to form a continuous and tight seal.

Previous installations had been made by the conventional method of applying stainless-steel sheets to back-up strips embedded in the concrete at the time of pouring. When a process modification necessitated the addition of a similar stainless-steel lining to an existing facility, the previous method of construction was found to be impracticable and uneconomical. The solution to this problem led to a procedure involving power-driven studs, which not only expedited the installation but also effected savings at both the design and the construction stages.

In the original installation, carbon-steel angles were used to serve as back-up strips placed at regular horizontal and vertical distances, as shown in Fig. 1. These angles, with anchor straps, were attached to the forms before the concrete was poured, in such a manner that the face of one leg was flush with the finished concrete surface. Contiguous edges of the stainless-steel sheets were butt-welded over the centerline of the exposed angle leg, or lap-

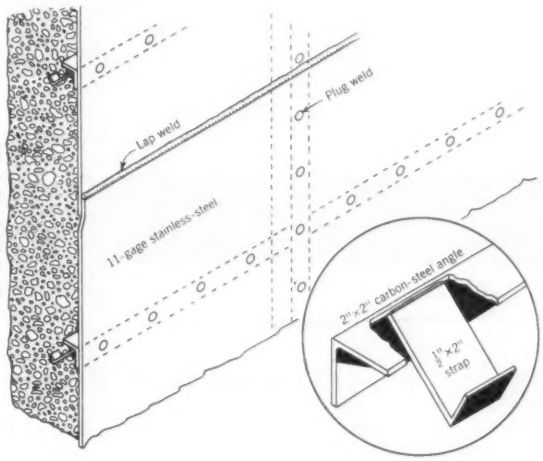


FIG. 1. Original method used for fastening stainless-steel sheets to concrete utilized carbon-steel angles attached to forms before concrete was poured.

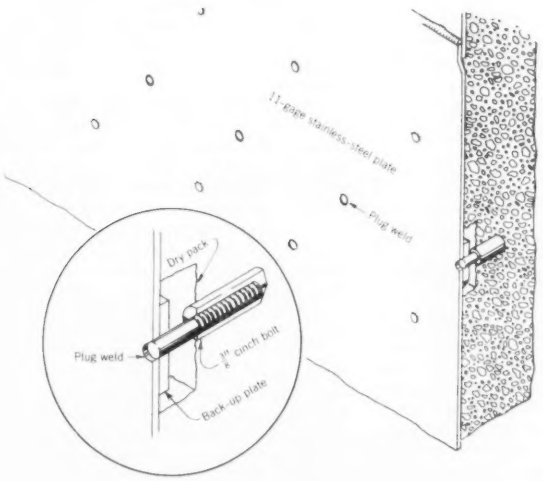


FIG. 2. Common method of attaching stainless-steel sheets to concrete already in place involves chipping out horizontal and vertical grooves to receive stainless-steel strips cinch-anchored to wall. Sheets are then welded to strips.

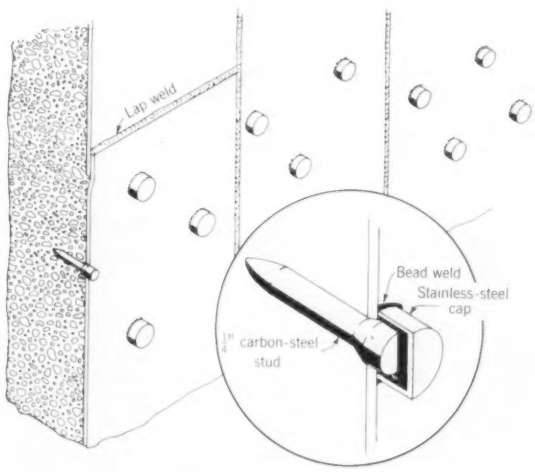


FIG. 3. New method for fastening stainless-steel sheets to concrete already in place employs power-driven studs on 18-in. centers, staggered each way. Surrounding sheets are lapped 1/4 in. over first sheet and laps are seam-welded. Studs are similarly driven. Carbon-steel stud projections are covered with stainless-steel caps, and seal-welded around perimeter.

welded as needed, giving a continuous seal. Plug welds, on 18-in. centers, were used to fasten the sheets to the back-up strips.

To apply this principle in the sheathing of existing concrete surfaces would require not only additional time-consuming labor in preparing the walls and floors, but also would necessitate the procurement of stainless steel in the exact sizes required at a time when any delay would have been intolerable.

Another common method of attaching sheets to a finished concrete surface is illustrated in Fig. 2. Back-up strips are placed after the concrete has set, but this requires chipping out both horizontal and vertical grooves to receive the 2-in. × $^3/_8$-in. stainless-steel strips, which then are cinch-anchored to the wall. Dry packing also is required around each back-up strip to insure firmness and a flush surface. After these three operations, the stainless-steel sheets, cut to size to correspond to the spacing of the back-up strips, are butt-welded and plug-welded to the strips as in the original installation.

Improved method developed

Instead of this costly and time-consuming procedure, the following method was developed, based on the use of power-driven studs. The elevation and section of a typical surface, sheathed according to the improved method, are shown in Fig. 3. A single sheet of stainless steel, of any available size, is fastened to the concrete by power-driven studs on 18-in. centers, staggered each way. Surrounding sheets then are lapped $^1/_4$ in. over the one in position. This lap is seam-welded, and each sheet is fastened to the concrete with power-driven studs as in the installation of the first or base sheet.

All stud projections are covered with stainless-steel caps, which are seal-welded around the perimeter. This operation was required because, at the time, only carbon-steel studs were readily available, and they required corrosion protection. If stainless-steel studs had been used, the seal-weld would have been necessary only around the head of the stud. The seal-weld, in either case, prevents the penetration of contaminated or corrosive fluids to the area behind the sheathing.

The new technique here described was developed during the course of work done under a contract with the Atomic Energy Commission, whose permission to publish this description is gratefully acknowledged.

THE READERS WRITE

Irrigated acreage in the United States

TO THE EDITOR: On page 31 of the June issue, incorrect acreages of irrigated land are given for California, Washington, and Oregon.

The Hoover Commission's Report to Congress dated June 1955 quotes the 1950 Census, which records a total of about 25.8 million irrigated acres in the United States. In 1953, the U. S. Bureau of Reclamation reported 7.15 million acres irrigated under federal projects, or 27.7 percent of the total. This would indicate that 18.65 million acres, or 72.3 percent, have been developed by non-federal agencies.

The irrigated acreage in ten leading states in 1954, as furnished by the office of the Commissioner of Reclamation, was as follows:

State	Millions of Acres	State	Millions of Acres
California	7.0	Oregon	1.5
Texas	4.7	Wyoming	1.3
Idaho	2.3	Nebraska	1.2
Colorado	2.2	Arizona	1.2
Montana	1.9	Utah	1.1

According to this source, the lands under irrigation in the United States in 1954 totaled 29.5 million acres, of which 26.9 million were in the 17 Western states.

The Task Group on Reclamation and Irrigation of the Hoover Commission made a rough prediction that during the next ten to twenty years another 10 million acres might well be irrigated, one-half of which would be by the U. S. Bureau of Reclamation. The Bureau considers that irrigation of another 17 million acres in the West is possible.

LYNN CRANDALL, M. ASCE
Watermaster, Water Dist. No. 36

Idaho Falls, Idaho

Can high school students intelligently "elect" courses?

TO THE EDITOR: With reference to all the recent furore over our lack of scientifically trained personnel, I believe our present-day lack of scientists and engineers can be traced directly to the dropping of Latin from the required curricula in high school, early in this century.

I am not going to argue the undoubted value of Latin as a disciplinary study. But when a student entering high school was permitted to choose between Latin and more Mathematics, the door was opened for other choices. Inevitably he asked the question, "If I am permitted to choose between Latin and Mathematics, why can't I choose between Physics and English? Between Science and participation in high school dramatics?" So all kinds of elective courses have been added—many of them naturally more appealing to the immature mind of the entering student than the hard work needed to complete college entrance requirements. (I note from the newspapers that a study recently conducted indicates that some 50,000 high schools would now like to institute an elective course in Fishing and Camping!)

The snowball doesn't end there. If, this year, very few students elected to take Physics, the Physics teacher was dropped from the payroll. Next year, although a number of students may want to study physics, no course will be offered.

So—our student is graduated from high school. He now is a little older; he desires to become a scientist or engineer. But he lacks the required preparatory work so he is unable to do so. He has been crippled. And we have permitted it!

By what stretch of the imagination can we justify letting a child of high school age "elect" his courses in high school? It seems to me we are almost criminally negligent in not returning to a required, fixed curriculum, designed to enable the graduate to pursue further study in any field he may later wish to enter.

K. S. ANDERSSON, M. ASCE
Col. (Ret.), Operations Analyst, Combat Operations Research Group, Continental Army Command

Fort Monroe, Va.

AMERICAN SOCIETY OF CIVIL ENGINEERS

1956 Annual Convention

Pittsburgh, Pa. — Penn-Sheraton Hotel (formerly Hotel William Penn), Pittsburgh, Pa. — October 15–19, 1956

Pittsburgh Section, Host

REGISTRATION

17th Floor, Penn-Sheraton Hotel (formerly Hotel William Penn)

Sunday, Oct. 14, 3:00 p.m. to 8:00 p.m. Each Convention day, 9:00 a.m. to 5:00 p.m.

Registration fee, $4.00 (except ladies and students).

ADVANCE INFORMATION ON ATTENDANCE

To assist in planning a smooth running Annual Convention for you, the Convention Committee would appreciate your help. Just fill out the coupon on page 135 and mail it to John E. Heinzerling, Chairman, Registration and Information Committee, 1956 ASCE Convention, c/o Richardson, Gordon & Associates, 3 Gateway Center, Pittsburgh 22, Pa.

This is not a preregistration. You will register when you arrive at the Convention.

Do not send payment for all events. The only event for which advance payment is required is the Dinner-Dance on October 17, details of which are given in the program.

You will provide invaluable assistance to the Committee by supplying this advance information.

HOTEL ACCOMMODATIONS

Headquarters of the Annual Convention will be the Penn-Sheraton Hotel located in the heart of Pittsburgh's Golden Triangle on Grant Street at Sixth Avenue. The hotel has reserved space to accommodate the expected reservations. Across the street is the Carlton House and about two blocks away is the Pittsburgher Hotel. Send in your request early, directly to the hotel of your choice. A special request form is provided for your convenience on page 139.

ROOMS FOR STUDENTS

Sleeping accommodations for visiting students are being arranged. Advance information and reservations are being coordinated by Prof. A. C. Ackenheil, Jr., Dept. of Civil Engineering, Univ. of Pittsburgh, Pittsburgh 13, Pa.

AUTHORS' BREAKFASTS

8:15 a.m. — **Penn-Sheraton Hotel**

Monday, Tuesday, Thursday, Friday, Terrace Room.

Wednesday, Allegheny Room.

Briefing sessions for speakers, discussers, and program officials for each day will take place at a breakfast meeting on the norning of the same day. Attendance is by invitation only.

Presiding: WILFRED BAUKNIGHT, Vice Chairman, Technical Program Committee.

MONDAY MORNING

OCT. 15

Engineering Mechanics Division

9:30 a.m. — **Fort Duquesne Room**

Symposium on Physics of Engineering Materials

Sponsored by Division's Committee on Mechanical Properties of Materials

Presiding: J. L. Waling, Member, Division's Committee on Mechanical Properties of Materials

9:30 Imperfections in Crystals
FREDERICK SEITZ, Professor of Physics and Technical Director, Control Systems Laboratory, Univ. of Illinois, Urbana, Ill.

10:15 Dislocations
THORNTON READ, JR., Member of the Technical Staff, Bell Telephone Laboratories, Murray Hill, N. J.

11:00 Internal Friction in Metals
CLARENCE M. ZENER, Acting Director of Research Laboratories, Westinghouse Electric Corp., Pittsburgh, Pa.

Construction Division

9:30 a.m. — **Monongahela Room**

Presiding: Charles M. Davis, Chairman, Executive Committee, Construction Division

9:30 Design Considerations for Atomic Power Reactor Containment Structure
L. P. ZICK, A. M. ASCE, Chicago Bridge and Iron Co., Chicago, Ill., and W. C. SELER, Atomic Power Development Associates, Detroit, Mich.

10:30 Magnesium in an Earth Satellite
JAMES S. KIRKPATRICK, Vice-President of Research and Development, Brooks and Perkins, Inc., Detroit, Mich.

Power Division

9:45 a.m. — **Ball Room**

Presiding: G. R. Strandberg, Member, Executive Committee, Power Division

9:45 The Use of Fly Ash in the Concrete for Shippingport Power Station
ROBERT J. MCALLISTER, Senior Project Engr., Duquesne Light Co., Pittsburgh, Pa.

10:30 Rock-Fill Dams with Sloping Impervious Core
JAMES P. GROWDON, M. ASCE, Consulting Engineer, Aluminum Co. of America, Pittsburgh, Pa.

Sanitary Engineering Division

9:30 a.m. — **Sky Room**

Sponsored by Division's Committee on Sewerage and Sewage Treatment

Presiding: Roy J. Morton, Chairman, Executive Committee, Sanitary Engineering Division; Co-chairman, Robert F. Brandt, Member, Division's Committee on Session Programs

9:30 Sludge Incineration
MARK B. OWEN, M. ASCE, Vice President, Nichols Engineering and Research Corp., Indianapolis, Ind.
Paper to be read by HERMAN F. LUNDBERG, M. ASCE, Partner, The Chester Engineers, Pittsburgh, Pa.

Discussion

JOSEPH M. LANE, A.M. ASCE, Nichols Engineering and Research Corp., Indianapolis, Ind.

10:00 Sludge Digestion

PAUL J. CERNY, Engr., Eastern Sanitary Div. of Dorr-Oliver, Inc., Stamford, Conn.

10:30 Factors Determining the Use of Sludge Digestion or Incineration

EUGENE R. DAVIS, A.M. ASCE, Engr., Morris Knowles, Inc., Pittsburgh, Pa.

11:00 Panel Discussion with Messrs. Lane, Cerny, and Davis

Panel Moderator: HERBERT J. DUNSMORE, A.M. ASCE, Public Health Engr., Pittsburgh, Pa.

Structural Division

9:15 a.m. **Urban Room**

Sponsored by Committee on Design in Lightweight Structural Alloys

Presiding: John Clark, Chairman, Committee on Design in Lightweight Structural Alloys, and Leo H. Corning, M. ASCE

9:15 Creative Design Development in Aluminum

E. J. DE RIDDER, Director, Engineering Development, Reynolds Metals Co., Louisville, Ky.

9:55 Aluminum Design for Military Bridges

F. J. TAMANINI, A.M. ASCE, Chief, Structural Design Branch, Civil Engineering Dept., Eng. Research and Development Laboratories, Corps of Engineers, U. S. Army, Ft. Belvoir, Va.

10:35 Large Welded Aluminum Structures

LUDWIG ADAMS, M. ASCE, Research Coordinator, Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa.

11:15 Fatigue Tests of Riveted or Bolted Aluminum Alloy

MARSHALL HOLT, A.M., ASCE, Asst. Chief, Eng. Design Div., Aluminum Co. of America, New Kensington, Pa.

I. D. EATON, Research Engr., Eng. Design Div., Aluminum Co. of America, New Kensington, Pa.

R. B. MATTHIESEN, J.M. ASCE, Research Engr., Eng. Design Div., Aluminum Co. of America, New Kensington, Pa.

Waterways and Harbors Division

9:15 a.m. **Allegheny Room**

Presiding: Charles M. Wellons, Chairman, Executive Committee, Waterways and Harbors Division

9:15 Modern Navigation Facilities for the Ohio River and Certain Tributaries

JAMES W. BRUCE, Chief of Planning and Reports Branch, Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

JAMES A. NEILL, Chief of Eng. Div., Pittsburgh Dist., Corps of Engineers, Pittsburgh, Pa.

DWIGHT W. KELLER, Civil Engr., Planning and Reports Branch, Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

9:55 Current Trends in Traffic and Equipment on the Ohio River and Its Tributaries

CHARLES F. MICHIELS, Chief of Operations Div., Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

WILLIAM F. LAIL, Asst. Chief of Operations Div., Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

ROBERT E. MYTINGER, Chief of Plant and Equipment Branch, Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

10:35 Flood Control Plan for the Ohio River Basin

BRUCE R. GILCREST, Chief of Hydraulics Branch, Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

EMIL P. SCHULEEN, M. ASCE, Asst. Chief of Eng. Div., Pittsburgh Dist., Corps of Engineers, Pittsburgh, Pa.

EDGAR W. LANDENBERGER, Asst. Chief of Planning and Reports Branch, Ohio River Div., Corps of Engineers, Cincinnati, Ohio.

11:15 Local Flood-Protection Projects, Ohio River Basin

SAMUEL M. BAILEY, M. ASCE, Chief of Eng. Div., Louisville Dist., Corps of Engineers, Louisville, Ky.

ROY E. KARLEN, A.M. ASCE, Asst. Chief of Eng. Div., Louisville Dist., Corps of Engineers, Louisville, Ky.

HARRY POCKRAS, Chief of Eng. Div., Huntington Dist., Corps of Engineers, Huntington, W. Va.

NUCLEAR ENERGY LUNCHEON

Monday, Oct. 15

12:00 noon **Ball Room**

Sponsored jointly by Sanitary Engineering, Structural Engineering and Engineering Mechanics Divisions and AIDIS (Inter-American Association of Sanitary Engineers)

Speaker: C. V. ROSEBERRY, Manager of Commercial Atomic Power Activities, Westinghouse Electric Corp.

Subject: An Appraisal of Atomic Power

Presiding: CLAYTON O. DOHRENWEND, Chairman, Executive Committee, Engineering Mechanics Division

Tickets for this event must be purchased before 10:00 a.m. on Monday. Per plate, $4.00.

MONDAY AFTERNOON OCT. 15

Construction Division

2:30 p.m. **Monongahela Room**

Presiding: Walter L. Couse, Chairman, Program Committee, Construction Division

2:30 Contemporary Design—Its Effect on Construction Costs of Modern Office Buildings

CHAN TURNER, JR., President, Turner Construction Co., New York, N. Y.

3:30 Our Labor Situation as It Affects Construction Today, and the Legislative Influences on these Conditions

WILLIAM DUNN, Asst. Executive DIRECTOR, Assoc. General Contractors of America, Washington, D. C.

Power Division

2:30 p.m. **Ball Room**

Presiding: G. R. Strandberg, Member, Executive Committee, Power Division

2:30 Coexistence of Migratory Fish and Dams in the Columbia River Basin

L. E. RYDELL, M. ASCE, Chief of Planning and Reports Branch, Walla Walla Dist., Corps of Engineers, Walla Walla, Wash.

H. A. PRESTON, M. ASCE, Chief, Flood Control & Survey Reports

Section, Walla Walla Dist., Corps of Engineers, Walla Walla, Wash.

3:15 Design Features of the Eklutna Project, Alaska

FRANK B. COOK, M. ASCE, Chief, General Eng. Branch, Bureau of Rec'amation, Denver, Colo.

DAVID L. GOODMAN, A.M. ASCE, Engr., Div. of Administrative Services, Bureau of Reclamation, Denver, Colo.

4:00 Foundation Problems of the Steam Plants on the TVA System

CLARENCE E. BLEE, M. ASCE, Chief Engr., Tennessee Valley Authority, Knoxville, Tenn.

Engineering Mechanics Division

2:30 p.m. **Ft. Duquesne Room**

Symposium on Physics of Engineering Materials

Sponsored by Committee on Mechanical Properties of Materials

Presiding: J. L. Waling, Member, Committee on Mechanical Properties of Materials, Engineering Mechanics Division

2:30 Materials for Shielding

E. P. BLIZARD, Director of Applied Nuclear Physics Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.

ALVIN M. WEINBERG, Research Director, Oak Ridge National Lab., Oak Ridge, Tenn.

3:15 Effect of Radiation on Material Properties

G. J. DIENES, Senior Physicist, Brookhaven National Lab., Upton, Long Island, N. Y.

4:00 Review and Discussion of Papers on Physics of Engineering Materials

GLENN MURPHY, M. ASCE, Prof. and Head of Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa.

Sanitary Engineering Division

2:30 p.m. **Sky Room**

Sponsored by Division's Committee on Industrial Waste Practice

Industrial Wastes

Presiding: Richard Hazen, Vice Chairman, Executive Committee, Sanitary Engineering Division

2:30 A River's Ability to Cleanse Itself

HAROLD A. THOMAS, JR., M. ASCE, Assoc. Prof., Sanitary Eng., Harvard Univ., Cambridge, Mass.

Discussion

3:00 Procedures for Computing the Capacity of Estuaries to Assimilate Pollution

THOMAS N. NILES, M. ASCE, Partner, Greeley & Hansen, Chicago, Ill.

Discussion

3:30 Acid Mine Drainage

L. S. MORAN, Div. Engr., Bur. of Sanitary Eng., Pennsylvania Dept. of Health, Greensburg, Pa.

Discussion

Structural Division

2:00 p.m. **Urban Room**

Sponsored by Committee on Design in Lightweight Structural Alloys

Presiding: Ernest C. Hartmann, Chairman, Executive Committee, Structural Division

2:00 Large Riveted Connections

WILLIAM H. MUNSE, A.M. ASCE, Research Prof. of Civil Eng., Univ. of Illinois, Urbana, Ill.

2:40 Effect of Initial Eccentricities on Column Performance and Capacity

J. M. HAYES, M. ASCE, Assoc. Prof. of Structural Eng., Purdue Univ., Lafayette, Ind.

3:20 Structural Connections

FREDERICK H. DILL, M. ASCE, Asst. to Vice President, Eng., American Bridge Div., U. S. Steel Corp., Pittsburgh, Pa.

Waterways and Harbors Division

2:00 p.m. **Allegheny Room**

Presiding: Charles M. Wellons, Chairman, Executive Committee, Waterways and Harbors Division

2:00 Design and Operating Characteristics of Roll-On Roll-Off Type Vessels

DOUGLAS C. MACMILLAN, President, George G. Sharp, Inc., New York, N. Y.

2:40 Shoreside Facilities for Roll-on Roll-Off and Other Special-Purpose Ships

HOWARD J. MARSDEN, Chief, Div. of Port Development, Maritime Admin., U. S. Dept. of Commerce, New York, N. Y.

3:20 Master Plan for Redevelopment of Two Miles of Obsolete Waterfront

DUNCAN S. REID, Manager, Planning Div., Marine Terminals Dept., Port of New York Authority, New York, N. Y.

4:00 Design and Utilization of Shipping Containers

DONALD A. BOOTH, M. ASCE, Asst. Chief Draftsman, Dravo Corp., Pittsburgh, Pa.

KICKOFF PARTY

Monday, Oct. 15

5:30–7:00 p.m. **Ballroom**

First general gathering of the Convention for all members and their wives.

Sponsored by the Pittsburgh Section. Tickets for admission without charge, obtainable upon registration.

This is where you meet your friends, renew acquaintances, and make a good start on the enjoyment that goes along with business at our Annual Convention. Plan your own dinner party with your friends after the cocktail party, and then see some of Pittsburgh at night. Ask at the registration desk for places to go and things to see.

TUESDAY MORNING

OCT. 16

Air Transport Division

9:30 a.m. **Ball Room**

Presiding: Joseph D. Blatt, Vice Chairman, Executive Committee, Air Transport Division

9:30 Research by Corps of Engineers on Cold Regions Air Transport Problems

ROBERT R. PHILIPPE, Chief Special Eng. Sect., Corps of Engineers, U. S. Army, Washington, D. C.

Discussion

R. F. LEGGET, M. ASCE, Director, Div. of Building Research, National Research Council of Canada, Ottawa, Canada.

10:45 Determination of the Capabilities of Compacted Snow Airstrips

J. A. BENDER, Chief, Snow and Ice Basic Research Branch, Snow, Ice and Permafrost Research Est., U. S. Army, Wilmette, Ill.

Discussion

Construction Division

9:00 a.m. **Allegheny Room**

Sponsored by the Committee on Pipelines

Presiding: Eldon V. Hunt, Chairman, Committee on Pipelines, Construction Division

9:00 Organization and Administration of a Cooperative Corrosion Committee

C. A. ERICKSON, Corrosion Engr., The Peoples Natural Gas Co., Pittsburgh, Pa.

10:00 Pressure-Pulsation Test of Branch Connections to Large-Diameter Pipe

H. H. GEORGE, Manager of Research Sect., Tube Turns, Louisville, Ky.

11:00 Pipe Mill Operations

W. L. FADER, Asst. Gen. Supt., National Tube Div., McKeesport, Pa.

Power Division

9:30 a.m. **Monongahela Room**

Presiding: R. B. Horner, Member, Program Committee, Power Division

9:30 Shippingport Power Station—General Features

R. B. DONWORTH, Vice President, Eng. and Construction Div., Duquesne Light Co., Pittsburgh, Pa.

10:15 Shippingport Power Station—General Features of Site and Turbine Generator Structures

WILLIAM A. CONWELL, M. ASCE, Structural Engr., Duquesne Light Co., Pittsburgh, Pa.

11:00 Structural Features of Nuclear Reactor Portion of Plant

H. T. EVANS, Structural Engr., Stone & Webster Eng. Corp., Boston, Mass.

Engineering Mechanics Division

9:30 a.m. **Sky Room**

Sponsored by Committee on Plasticity Related to Design

Presiding: Daniel C. Drucker, Member, Committee on Plasticity Related to Design, Engineering Mechanics Division

9:30 Experimental Demonstrations of Plastic Behavior of Steel Frames

H. M. NELSON, Asst. Prof. of Civil Eng., Royal Military College of Canada, Kingston, Ont.

D. T. WRIGHT, Asst. Prof. of Civil Eng., Queens Univ., Kingston, Ont.

J. W. DOLPHIN, Head, Dept. of Civil Eng., Royal Military College of Canada, Kingston, Ont.

10:00 Plastic Design of Multi-Span Rigid Frames

ROBERT L. KETTER, J.M. ASCE, Research Asst. Prof., Dept. of Civil Eng., Lehigh Univ., Bethlehem, Pa.

10:30 On Inelastic Local Buckling in Steel

G. HAAIJER, Technologist, Applied Research Lab., U. S. Steel Corp., Monroeville, Pa.; former Research Asst., Fritz Eng. Lab., Lehigh Univ., Bethlehem, Pa.

B. THURLIMANN, Research Assoc. Prof., Dept. of Civil Eng., Lehigh Univ., Bethlehem, Pa.

11:00 Experimental and Theoretical Developments in Plastic Analysis and Design

R. M. HAYTHORNTHWAITE, A.M. ASCE, Asst. Prof., Div. of Eng., Brown Univ., Providence, R. I.

Sanitary Engineering Division

9:30 a.m. **Ft. Duquesne Room**

Engineering Practice

Presiding: Roy E. Lawrence, Member, Executive Committee, Sanitary Engineering Division

9:30 Relationship Between the Consulting Engineer and Industry

D. H. MILLER, Resident Engr., Pittsburgh Works, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

Discussion

10:00 Sanitary Engineer of the Future

THEODORE F. HATCH, Prof. of Industrial Health Eng., Graduate School of Public Health, Univ. of Pittsburgh, Industrial Hygiene Foundation, Pittsburgh, Pa.

Discussion

10:30 Engineering Specifications — for Quality, Not Price

MORRIS M. COHN, M. ASCE, Editor, *Waste Engineering*, and Editorial Director, *Water Works Engineering*, New York, N. Y.

Discussion

Waterways and Harbors and Hydraulics Divisions—Joint Session

9:15 a.m. **Urban Room**

Presiding: Charles M. Wellons Chairman, Executive Committee, Waterways and Harbors Div.

9:15 The Littoral Drift Problem at Shoreline Harbors

J. W. JOHNSON, M. ASCE, Prof. of Hydraulic Eng., Univ. of Calif., Berkeley, Calif.

9:55 Hurricane Wave Design Practices

C. L. BRETSCHNEIDER, A.M. ASCE, Research Engr., Beach Erosion Board, U. S. Corps of Engineers, Washington, D. C.

10:35 Wave Forces on Cylindrical Piles

R. L. WIEGEL, Assoc. Research Engr., Inst. of Eng. Research, Univ. of Calif., Berkeley, Calif.

K. E. BEEBE, J.M. ASCE, Lt. USAR Ordnance Corps, Berkeley, Calif.

JAMES MOON, Consulting Engineer, Signal Oil & Gas Co., Los Angeles, Calif.

CIVIL WORKS LUNCHEON

Tuesday, Oct. 16

12:00 noon **Ball Room**

Sponsored jointly by Construction, Hydraulics, and Waterways and Harbors Divisions

Presiding: CHARLES M. WELLONS, Chairman, Executive Committee, Waterways and Harbors Division

Speaker: MAJ. GEN. EMERSON C. ITSCHNER, M. ASCE, Chief of Engineers, U. S. Army, Washington, D.C.

Subject: Tomorrow's Demands Will Be Greater

Per plate $4.00

TUESDAY AFTERNOON

OCT. 16

Air Transport Division

2:30 p.m. **Ball Room**

Presiding: Joseph D. Blatt, Vice Chairman, Executive Committee, Air Transport Division

2:30 Aircraft Operations on Floating Ice Sheets

S. R. STEARNS, A.M. ASCE, Prof. of Civil Eng., Dartmouth College, Hanover, N. H.

Discussion

3:45 Airfield Construction on Permafrost

KENNETH A. LINELL, A.M. ASCE, Chief, Arctic Construction and Frost Effects Lab., New England Div., Corps of Engineers, Boston, Mass.

Discussion

K. B. Woods, M. ASCE, Head, Civil Eng. Dept., Purdue Univ., Lafayette, Ind.

Construction Division

2:00 p.m. **Allegheny Room**

Sponsored by the Committee on Pipelines, Construction Division

Presiding: Fred C. Culpepper, Jr., A.M. ASCE

2:00 High-Pressure Steam-Main Installation in Lower Manhattan

James C. Fisher, A.M. ASCE, Senior Engr., Consolidated Edison Co., New York, N. Y.

3:00 Right-of-Way Problems as They Affect the Engineer

F. A. Smith, Land Dept. Supervisor, Ford, Bacon & Davis, Inc., New York, N. Y.

4:00 Progress in Development of Line Pipe Steel

A. B. Wilder, Chief Metallurgist, National Tube Div., U. S. Steel Corp., Pittsburgh, Pa.

Engineering Mechanics Division

2:30 p.m. **Sky Room**

Sponsored by Division's Committees on Mathematical Methods and on Plasticity Related to Design

Presiding: Clayton O. Dohrenwend, Chairman, Executive Committee, Engineering Mechanics Division

2:30 Graphical Solution of Two Simultaneous First-Order Ordinary Differential Equations with Application to Hydraulic Vibrations

Wen-Hsiung Li, A.M. ASCE, Assoc. Prof. of Civil Eng., The Johns Hopkins Univ., Baltimore, Md.

3:00 The Pressure Line Concept and the Inelastic Buckling of Columns

Frank Baron, M. ASCE, Prof. of Civil Eng., Univ. of Calif., Berkeley, Calif.

3:30 Lateral Buckling of Plane Frameworks

E. F. Masur, A.M. ASCE, Assoc. Prof. of Eng. Mechanics, Univ. of Michigan, Ann Arbor, Mich.

A. Cukurs, Structural Engr., Procon Incorporated, Chicago, Ill.

Highway Division

2:30 p.m. **Monongahela Room**

Presiding: J. W. McKnight, Member, Program Committee, Highway Division

2:30 Full-Scale Highway Research—AASHO Road Test

Fred Burggraf, M. ASCE, Director, Highway Research Board, National Academy of Sciences-National Research Council, Washington, D. C.

3:15 Tests to Evaluate the Influence of Subbase Thickness on Concrete Pavement Design

L. D. Childs, Senior Development Engr., Portland Cement Assoc. Research and Development Lab., Skokie, Ill.

B. E. Colley, Development Engr., Portland Cement Assoc. Research and Development Lab., Skokie, Ill.

J. W. Kapernick, J.M. ASCE, Assoc. Dept. Engr., Portland Cement Assoc. Research and Development Lab., Skokie, Ill.

(L. D. Childs will present the paper.)

3:45 The Use of Granulated Slag as Subbase for Pavements

G. A. Oakes, J.M. ASCE, Soils Engr., Richardson, Gordon and Associates, Pittsburgh, Pa.

Hydraulics and Waterways and Harbors Divisions—Joint Session

2:00 p.m. **Urban Room**

Presiding: Professor Wallace M. Lansford, Vice Chairman, Executive Committee, Hydraulics Div., and Clarence F. Wicker, Chairman, Committee on Tidal Hydraulics

2:00 An Approach to Hurricane Tide Prediction

Robert L. Reid, A.M. ASCE, Prof., Dept. of Oceanography, Texas A. & M. College, College Station, Tex.

3:15 The Effect of Hurricanes on Sea Level in Charleston Harbor

Bernard Zettler, Div. of Tides and Currents, U. S. Coast & Geodetic Survey.

4:00 Laboratory Study of Wind Tides in Shallow Water

J. W. Johnson, M. ASCE, Prof. of Hydraulic Eng., Univ. of Calif., Berkeley, Calif.

O. J. Sibul, Asst. Research Engr., Inst. of Eng. Research, Univ. of California, Berkeley, Calif.

POWER DIVISION FIELD TRIP

Tuesday, Oct. 16

12:00 noon

Trip: To inspect America's first full-scale atomic power station being built by the Atomic Energy Commission and the Duquesne Light Co. at Shippingport, Pa.

Departure: 12:00 noon at Penn-Sheraton Hotel.

Return: 5:30 p.m. at Penn-Sheraton Hotel.

Transportation: By bus.

Lunch: To be served in the Horizon Room of the Greater Pittsburgh Airport.

Price per person: $5.50, includes transportation, lunch, and gratuities.

Registration: At Convention registration desk not later than 10:00 a.m., Oct. 16.

ASCE MEMBERS ONLY

Sanitary Engineering Division

2:30 p.m. **Ft. Duquesne Room**

Air Pollution

Presiding: Robert R. Kennedy, Member, Executive Committee, Sanitary Engineering Division

2:30 Basic Considerations in the Measurements of Air Contaminants

Wesley C. Hemeon, Director, Hemeon Associates, Pittsburgh, Pa.

Discussion

3:00 Allegheny County Story of Smoke and Air Pollution Control

T. C. Wurts, Director, Allegheny County, Bureau of Smoke Control, Pittsburgh, Pa.

John J. Grove, Asst. Director, Allegheny Conf. on Community Development, Pittsburgh, Pa.

Discussion

3:30 The Impact of Radioactive Wastes on Sanitary Engineering

Mark D. Hollis, M. ASCE, Asst. Surgeon General; Chief, Div. of Sanitary Eng. Services, U. S. Government, Washington, D. C.; and James G. Terrill, Jr., A.M. ASCE, Acting Chief, Radiological Health Branch, Div. of Eng. Resources, USPHS, Washington, D. C.

Discussion

TUESDAY EVENING

OCT. 16

STRUCTURAL DIVISION EVENING TOUR

7:00 p.m.

Trip: Tour of the Mellon-U. S. Steel Building and the Aluminum Co. of America Building.

Time: 7:00 to 9:30 p.m.

Location: These buildings flank Mellon Square, adjacent to the Convention Hotel.

Registration: At Convention registration desk *not* later than 5:00 p.m. Tuesday, Oct. 15.

No charge.

CONSULTANTS' DINNER

Tuesday, Oct. 16

There will be a regional dinner meeting of the American Institute of Consulting Engineers, details of which will be announced in later Convention publicity.

WEDNESDAY MORNING

OCT. 17

Annual Business Meeting of ASCE

10:00 a.m. **Urban Room**

10:00 Annual Reports

By the President
By the Executive Secretary

10:30 Presentation of Awards

Norman Medal to Carl Kindsvater, M. ASCE, Regent's Prof. of Civil Eng., Georgia Inst. of Technology, Atlanta; and Rolland W. Carter, A.M. ASCE, Chief of Research Sect., Surface Water Branch of U. S. Geological Survey, Washington, D. C.

J. James R. Croes Medal to Jack W. Carter, A.M. ASCE, Chief Product Design Staff, The Glenn L. Martin Co., Baltimore, Md.; Kenneth H. Lenzen, A.M. ASCE, Assoc. Prof., Dept. of Applied Mechanics, Univ. of Kansas, Lawrence; and Lawrence T. Wyly, M. ASCE, Prof., Research, Civil Eng., Northwestern Univ., Technological Inst., Evanston, Ill.

Thomas Fitch Rowland Prize to Jonathan Jones, Hon. M. ASCE, Bethlehem, Pa.

James Laurie Prize to Samuel I. Zack, M. ASCE, Chief, Sanitary Div., Gannett Fleming Corddry and Carpenter Inc., Engineers, Harrisburg, Pa.

Arthur M. Wellington Prize to John Hugh Jones, A.M. ASCE, Asst. Prof. of Eng., Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley, Calif.; and Robert Horonjeff, A.M. ASCE, Prof. of Transportation Eng. and Research Engr., Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley, Calif.

Collingwood Prize for Junior Members to John H. Schmertmann, J.M. ASCE, Sgt., U. S. Army Corps of Engineers, Snow, Ice and Permafrost Research Est., Wilmette, Ill.

J. C. Stevens Award to Serge Leliavsky, M. ASCE, Hydraulic and Structural Engr., Maadi (near Cairo), Egypt.

Rudolph Hering Medal to Thomas R. Camp, M. ASCE, Senior Partner, Camp, Dresser & McKee, Consulting Engineers, Boston, Mass.

Leon S. Moisseiff Award to George S. Vincent, M. ASCE, Bridge Engr., Physical Research Branch, Bur. of Public Roads, Washington, D. C.

James W. Rickey Medal to Adolf A. Meyer, M. ASCE, Chief Design Engr., Corporacion Autonoma, Regional del Cauca, Cali, Colombia.

Thomas H. Middlebrooks Award to Allen J. Curtis, Lecturer in Engineering, Univ. of Calif., Los Angeles, Calif.; and Frank E. Richart, Jr., A.M. ASCE, Prof. of Civil Eng., Univ. of Florida, Gainesville, Fla.

Construction Engineering Prize to Arve S. Wikstrom, A.M. ASCE A. S. Wikstrom Inc., Skaneateles, N. Y.

Ernest E. Howard Award to Ralph E. Boeck, M. ASCE, Prof., Marquette Univ., Milwaukee, Wis.

11:00 Inauguration of Pipeline Division

Transaction of Society business

11:15 Installation of Officers for 1956-1957

Report of Tellers on Ballot Canvass
Installation of Directors
Installation of Vice Presidents
Installation of President

11:30 President's Keynote Address

Adjournment for Membership Luncheon

ANNUAL MEMBERSHIP LUNCHEON

Wednesday, Oct. 17

12:30 p.m. **Ballroom**

Sponsored by Committee on Conditions of Practice

Toastmaster: PARK H. MARTIN, Hon. M. ASCE, General Chairman, 1956 ASCE Convention.

Welcoming Remarks: HON. DAVID L. LAWRENCE, Mayor, City of Pittsburgh, Pa.

Speaker: I. W. WILSON, President, Aluminum Company of America.

Subject: The Community and the Engineer.

Honorary Membership Awards: By PAST PRESIDENT ENOCH R. NEEDLES to:

GEORGE W. BURPEE, M. ASCE, Partner, Coverdale & Colpitts, New York, N. Y.

ALBERT HAERTLEIN, M. ASCE, Assoc. Dean, Div. of Eng. and Applied Physics, Harvard Univ., Cambridge, Mass.

THOMAS M. ROBINS, M. ASCE, Maj. Gen. U.S.A. Retired, Portland, Ore.

OLE SINGSTAD, M. ASCE, Consulting Engr., Singstad and Baillie, New York, N. Y.

RALPH B. WILEY, M. ASCE, Prof. of Civil Eng. Emeritus, Purdue Univ., Lafayette, Ind.

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon.

Per plate, $4.00. Tickets must be purchased before 10:00 a.m. on Wednesday.

WEDNESDAY AFTERNOON

OCT. 17

Committee on Conditions of Practice

2:30 p.m. **Sky Room**

Presiding: Frank L. Weaver, Retiring Chairman, Department of Conditions of Practice

Public Relations—A Symposium

2:30 From Standpoint of the Society

CHARLES M. BAYER, Public Relations Consultant to ASCE, New York, N. Y.

3:00 From Standpoint of Local Sections

V. G. THOMASSEN, M. ASCE,

President, Philadelphia Section, ASCE.

3:30 From Standpoint of the Branch

Engineering Mechanics Division

2:30 p.m. **Allegheny Room**

Presiding: Harry N. Hill, Member, Executive Committee, Engineering Mechanics Division

2:30 On the Dynamic Strength of Rigid-Plastic Beams Under Blast Loads

PAUL WEIDLINGER, M. ASCE, Consulting Engineer, New York, N. Y.

MARIO SALVADORI, M. ASCE, Prof. of Civil Eng., Columbia Univ., New York, N. Y.

3:00 Lateral Buckling of I-Beams Subjected to Unequal End Moments

J. W. CLARK, J.M. ASCE, Engr., Eng. Design Div., Alcoa Research Laboratories, New Kensington, Pa.

J. R. JOMBACK, J.M. ASCE, Engr., Eng. Design Div., Alcoa Research Laboratories, New Kensington, Pa.

3:30 Lateral Bracing Forces in Beams and Columns

WILLIAM ZUK, Assoc. Prof. of Civil Eng., Univ. of Virginia, Charlottesville, Va.

Highway Division

2:30 p.m. **Urban Room**

Expressway Problems Unlimited —a Symposium

Presiding: E. H. Karrer, Chairman, Executive Committee, Highway Division

2:30 Legislative Problems

DAVID R. LEVIN, Chief, Land Studies Sect., Bur. of Public Roads, and Secretary, Committee on Highway Laws, Highway Research Board, Washington, D. C.

3:00 Problems of Administrative Controls

Speaker to be announced.

3:20 Legal Problems

JOSEPH D. BUSCHER, Special Asst. Attorney General, Maryland State Roads Commission, Baltimore, Md.

3:40 Problems of Traffic Congestion

SAMUEL P. BROWN, Partner, Coverdale and Colpitts, New York, N. Y.

4:00 Problems of Engineering Management

EDWARD J. DONNELLY, M. ASCE, Partner, The J. E. Greiner Co., Baltimore, Md.

4:20 Discussion, with panel members taking up questions from the floor

Hydraulics Division

2:30 p.m. **Ft. Duquesne Room**

Flood Insurance

Presiding: Wallace M. Lansford, Vice Chairman, Executive Committee, Hydraulics Division

2:30 Technical Problems of Flood Insurance

H. ALDEN FOSTER, M. ASCE, Principal Associate, Parsons Brinckerhoff, Hall & Macdonald, New York, N. Y.

3:15 Influence of Meteorology and Hydrology on a Flood Insurance Program

A. A. KOCH, Consulting Engineer, Palo Alto, Calif.

4:00 Flood Insurance from the Viewpoint of the Private Insurance Companies

JOHN F. NEVILLE, Associate Secretary, American Insurance Association.

Sanitary Engineering Division

2:30 p.m. **Monongahela Room**

Nuclear Energy

Presiding: Roy J. Morton, Chairman, Executive Committee, Sanitary Engineering Division

2:30 Latest Developments in the Treatment of Atomic Wastes

CONRAD P. STRAUB, A.M. ASCE, Chairman, Committee on Sanitary Aspects of Nuclear Energy, Oak Ridge, Tenn.

Discussion

3:00 Significant Parameters in the Selection of Sites for Atomic Energy Plants

ARTHUR E. GORMAN, M. ASCE, Sanitary Engr., Div. of Reactor Development, U. S. Atomic Energy Commission, Washington, D. C.

Discussion

3:30 The Bio-Physical Basis of Tolerance Values in Radioactive Contaminants in Air and Water

HERMAN CEMBER, Asst. Prof. of Industrial Hygiene (Health Physics), Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh, Pa.

MAURICE A. SHAPIRO, A.M. ASCE, Asst. Prof. of Sanitary Eng., Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh, Pa.

Discussion

ANNUAL DINNER, DANCE, AND JOHN FRITZ MEDAL AWARD

Wednesday Evening

6:30 p.m. Cocktail Party, Urban Room Sponsored by Pittsburgh Section, ASCE

7:30 p.m. ASCE National Convention Dinner

Award of John Fritz Medal to

BEN MOREELL, Hon. M. ASCE, Admiral (CEC) U.S.N. Retired, Chairman of Board and Chief Executive Officer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Ballroom. $10.00 per plate.

Arrangements may be made for reserving tables of 8 or 10.

Orders for tables must be accompanied by check in full, and sent to John E. Heinzerling, Chairman, Registration and Information Committee, ASCE Convention, c/o Richardson, Gordon & Associates, 3 Gateway Center, Pittsburgh 22, Pa.

The published seating list will close at 12:00 noon Tuesday, October 16th. Tickets purchased after that hour will be assigned to tables in order of purchase.

9:00 p.m. President's Reception and Dance, Urban Room

The Pittsburgh Section is also acting as host for the formal dance from 9 p.m. to 1 a.m. One of Pittsburgh's leading orchestras will play for the dance, for which there will be no charge.

Formal dress.

THURSDAY MORNING

OCT. 18

City Planning, Highway, Structural Divisions— Joint Session

9:30 a.m. **Urban Room**

Highways in the Pittsburgh Renaissance—a Symposium

Presiding: George S. Richardson, Director, ASCE

9:30 Coordination of Plans and Action

WM. R. B. FROEHLICH, A.M. ASCE, Executive Director, Public Parking Authority of Pittsburgh, Pittsburgh, Pa.

10:15 Pittsburgh Arterial Highway Routes

JOSEPH BARNETT, M. ASCE, Asst.

Deputy Commissioner, Bur. of Public Roads, Washington, D. C.

10:55 Unique Structural Features of the Penn-Lincoln Parkway

C. R. Way, J.M. ASCE, Associate, Richardson, Gordon and Associates, Pittsburgh, Pa.

11:35 Conclusion and Discussion

Committee on Conditions of Practice

9:30 a.m. **Ballroom**

Presiding: Glenn W. Holcomb, Incoming Chairman, Department of Conditions of Practice

Subject: Does the Large Engineering Office Pose Special Challenges to the Employer and Employee?

Symposium

Public Organizations

H. E. Sprague, M. ASCE, Colonel, Corps of Engineers, U.S.A. District Engineer, Pittsburgh, Pa.

Private Organizations

Michael Baker, Jr., M. ASCE, President, Michael Baker, Jr., Inc., Rochester, Pa.

C. W. Griffin, Jr., J.M. ASCE, Robert E. Lamb & Son Inc., Philadelphia, Pa.

CONSTRUCTION DIVISION FIELD TRIP

(Pipe Line Committee)

Thursday, Oct. 18, 9:30 a.m.

Trip: To National Tube Division of U. S. Steel Corporation, McKeesport, Pa., Plant, to inspect pipe-making facilities.

Departure: From Penn-Sheraton Hotel at 9:30 a.m.

Return: To Penn-Sheraton Hotel at 5:00 p.m.

Transportation: By bus.

Registration: At Convention registration desk not later than 5:00 p.m., Tuesday, Oct. 16.

Lunch and Transportation: No charge for guests. Furnished through courtesy of National Tube Division, U. S. Steel Corporation.

CONSTRUCTION DIVISION FIELD TRIP

Thursday, Oct. 18, 9:00 a.m.

Trip: To inspect new Allegheny County Institution District Home and Hospital now under construction.

Location: Vanadium Road, Scott Township, Pittsburgh, Pa. (approximately 20 minutes from downtown Pittsburgh).

Travel: By bus from hotel.

Departure: 9:00 a.m. from Penn-Sheraton Hotel.

Return: 12:00 noon to Penn-Sheraton Hotel.

Cost: Bus fare, round-trip $1.00.

Project: 2,088-bed home and hospital for the aged. Estimated cost: $22,000,000. Scheduled completion, May 1957.

Registration: At Convention registration desk not later than 5 p.m., Tuesday, Oct. 16.

Hydraulics Division

9:30 a.m. **Ft. Duquesne Room**

Presiding: Wallace M. Lansford, Vice Chairman, Executive Committee, Hydraulics Division

9:30 Stilling Basin Experience of the Corps of Engineers

R. H. Berryhill, A.M. ASCE, Civil Engineer, U. S. Corps of Engineers, Dallas, Tex.

10:15 A Study of Bucket-Type Energy Dissipater Characteristics

M. B. McPherson, A.M. ASCE, Assoc. Prof. Civil Eng., Lehigh Univ., Bethlehem, Pa.

11:00 Simplified Sloping-Apron Stilling-Basin Design

J. N. Bradley, Hydraulics Engr., U. S. Bur. of Reclamation, Denver, Colo.

Sanitary Engineering Division

9:30 a.m. **Allegheny Room**

Joint session with Sanitary Engineering Division and U. S. A. Section of the Inter-American Society of Sanitary Engineers

Presiding: George E. Barnes, M. ASCE, Program Chairman, U. S. Section, Inter-American Society of Sanitary Engineers

9:30 Development of Sewerage Facilities at Medellin, Colombia

Kenneth V. Hill, M. ASCE, Partner, Greeley and Hansen, Chicago, Ill.

Discussion

10:00 Technical Assistance in Sanitary Engineering Education in Peru

Marvin L. Granstrom, Assoc. Prof. of Sanitary Eng., School of Public Health, Univ. of North Carolina, Chapel Hill, N. C.

10:30 Expansion of Sewer System for Cali, Colombia

Jaime Amorocho, Managing Engr., R. J. Tipton & Associates, Bogota, Colombia.

Soil Mechanics and Foundations Division

9:30 a.m. **Monongahela Room**

Symposium on Grouting

Presiding: R. E. Davis, Chairman, Committee on Grouting, Soil Mechanics and Foundations Division

9:30 Present Status of Cement Grouting of Foundations

A. W. Simonds, M. ASCE, Engr., U. S. Bur. of Reclamation, Denver, Colo.

9:45 Present Status of Clay Grouting

S. J. Johnson, M. ASCE, Assoc. Partner, Moran, Proctor, Mueser and Rutledge, New York, N. Y.

10:00 Specifications for Foundation Treatment

J. P. Elston, A.M. ASCE, Civil Engr., U. S. Bur. of Reclamation, Denver, Colo.

10:20 Discussion

10:40 Cement Grouting of Rock Foundations under Corps of Engineers Practice

E. B. Burwell, Jr., Chief, Geology and Geophysics Branch, Corps of Engineers, Dept. of the Army, Washington, D. C.

11:00 Discussion

11:20 Pressure Grouting with Packers

F. H. Lippold, M. ASCE, Civil Engr., U. S. Bur. of Reclamation, Denver, Colo.

Discussion

Surveying and Mapping Division

9:30 a.m. **Sky Room**

Presiding: B. H. Beavin, Sr., Chairman, Executive Committee, Surveying and Mapping Division

9:30 Survey Problems—Land Distribution in Philippines

George H. Harding, A.M. ASCE, Consulting Engineer, Columbus, Ohio.

10:15 Application of Photogrammetry to Civil Engineering Projects

WILLIAM O. BAKER, J.M. ASCE, Chief Photogrammetric Engr., Michael Baker, Jr., Inc., Rochester, Pa.

11:00 Aerial Triangulation Reduces Field Work in Photogrammetry

ROBERT A. CUMMINGS, JR., M. ASCE, Partner, Robert A. Cummings, Jr., & Associates, Pittsburgh, Pa.

11:30 Ontario Hydro Survey Program on the St. Lawrence

W. H. WILLIAMS, O.L.S., Chief Surveyor, The Hydro Electric Power Commission of Ontario, Toronto, Canada.

STUDENT CHAPTER CONFERENCE

9:30 a.m. **Pittsburgh Room**

Presiding: J. W. Graham, Jr., A.M. ASCE, Vice President, The Cooper Union, New York, N. Y.

9:30 Introduction of Chapter Representatives and Greetings

ALLEN P. RICHMOND, JR., M. ASCE, Asst. to the Secretary, ASCE.

10:00 Panel Discussion: The Next Five Years . . .

In Public Service

ROBERT B. PEASE, A.M. ASCE, Asst. Executive Director of Urban Redevelopment Authority of Pittsburgh, Pa.

In Construction

HOWARD H. STURDY, M. ASCE, Vice President and General Manager, Contracting Div., Dravo Corp., Neville Island, Pittsburgh, Pa.

In Consulting Practice

CHARLES E. DELEUW, M. ASCE, President, DeLeuw, Cather and Co., Chicago, Ill.

In Education and Research

HARRY S. ROGERS, M. ASCE, President, Polytechnic Inst. of Brooklyn, Brooklyn, New York.

In Industry

ARTHUR E. MORGAN, Hon. M. ASCE, President, Community Service, Inc., Yellow Springs, Ohio.

Discussion

STUDENT CHAPTER CONFERENCE LUNCHEON

Thursday, Oct. 18

12:30 p.m. **Pittsburgh Room**

Presiding: A. C. ACKENHEIL, JR., A.M. ASCE, Prof. of Civil Eng., Univ. of Pittsburgh, Pa.

Introduction: ENOCH R. NEEDLES, President, ASCE.

Address: MASON G. LOCKWOOD, President-Elect, ASCE.

Per plate, $2.50 maximum.

HIGHWAY DEVELOPMENT LUNCHEON

Thursday, Oct. 18

12:00 p.m. **Ball Room**

Sponsored jointly by Highway, Soil Mechanics and Foundations, and Surveying and Mapping Divisions

Speaker: REX M. WHITTON, M. ASCE, Chief Engr., Missouri State Highway Commission, Jefferson City, Mo., and President, American Assoc. of State Highway Officials.

Subject: Adequate Highways for America.

Presiding: CARL B. JANSEN, Chairman, Convention Technical Program Committee.

Tickets $4.00.

THURSDAY AFTERNOON OCT. 18

City Planning Division

2:30 p.m. **Allegheny Room**

Urban Renewal in the Pittsburgh Area and Nationally

Presiding: Fred W. Tuemmler, Chairman, Executive Committee, City Planning Division

2:40 The Place of the City Planner in Pittsburgh Renewal Projects

PATRICK J. CUSICK, JR., M. ASCE, Asst. Director, Pittsburgh Regional Planning Assoc., Pittsburgh, Pa.

3:00 Financial, Legal, and Administrative Aspects of Pittsburgh's Renewal Projects

THEODORE L. HAZLETT, JR., Executive Director, Urban Redevelopment Authority of Pittsburgh, Pa.

3:20 The Role of the Engineer in Pittsburgh's Renewal Projects

ROBERT B. PEASE, A.M. ASCE, Asst. Director, Urban Redevelopment Authority of Pittsburgh, Pa.

3:40 The Current National Picture with Respect to Urban Renewal

RICHARD L. STEINER, M. ASCE, Deputy Urban Renewal Commissioner, Housing and Home Finance Agency, Washington, D. C.

Highway Division

2:30 p.m. **Urban Room**

Expressway Problems Unlimited —a Symposium

Following this symposium the speakers will form a panel to discuss questions from the floor.

Presiding: Harmer E. Davis, Member, Executive Committee, Highway Division

2:30 Construction Plans and Specifications

RICHARD A. HABER, A.M. ASCE, Chief Engr., Delaware State Highway Dept. and Delaware Interstate Highway Div. (Toll), Dover, Del.

3:00 Problems in Contract Engineering on Highways

NOMER GRAY, M. ASCE, Associate, Ammann and Whitney, New York, N. Y.

3:30 Constructor's Contract Problems

CHARLES E. MCKEE, Executive Secretary, Ohio Contractors' Association, Columbus, Ohio.

4:00 Operating Problems of Maintaining Uninterrupted Use

H. G. YEAGER, General Maintenance Supt., Pennsylvania Turnpike Commission, Harrisburg, Pa.

Hydraulics Division

2:30 p.m. **Ft. Duquesne Room**

Turbulence in Fluid Flow

Presiding: Wallace M. Lansford, Vice Chairman, Executive Committee, and Joe W. Johnson, Chairman, Committee on Research, Hydraulics Division

2:30 Introductory Remarks

J. M. ROBERTSON, M. ASCE, Member, Committee on Research, Hydraulics Division; Prof. of Theoretical and Applied Mechanics, Univ. of Illinois, Urbana, Ill.

2:45 Some Turbulence Measurements in Water with an Impact Tube-Pressure Cell Combination

A. T. IPPEN, M. ASCE, Prof. of Hydraulics, Mass. Inst. of Technology, Cambridge, Mass.

R. S. TANKIN, J.M. ASCE, Harvard Univ., Cambridge, Mass.

F. RAICHLEN, J.M. ASCE, Engr.,

Hydrodynamics Sect., Glenn L. Martin Co., Baltimore, Md.

3:30 Turbulence in a Diffuser Boundary Line

J. M. ROBERTSON, M. ASCE, Member, Committee on Research, Hydraulics Division; Prof. of Theoretical and Applied Mechanics, Univ. of Illinois, Urbana, Ill.

G. L. CALEHUFF, Research Assoc., Ordnance Research Lab., Penn. State Univ., University Park, Pa.

4:15 Experimental Investigations of Shear Turbulence in Liquid Flows

H. A. EINSTEIN, M. ASCE, Prof. of Hydraulic Eng., Univ. of Calif., Berkeley, Calif.

L. M. GOSSMAN, Assoc. Prof. of Mechanical Eng., Univ. of Calif., Berkeley, Calif.

HUON LI, Asst. Research Engr., Univ. of Calif., Berkeley, Calif.

Surveying and Mapping Division

2:30 p.m.

"Open" Executive Committee Meeting

Presiding: B. E. Beavin, Sr., Chairman, Executive Committee, Surveying and Mapping Division

The Proposed Change in the Inch-Meter Relationship

Further Consideration of the Task Force Committee's Work on Professional Status

Consideration of a Proposed Program of Research

Soil Mechanics and Foundations Division

2:30 p.m. **Monongahela Room**

Symposium on Grouting
(continued)

Presiding: R. E. Fadum, Member, Executive Committee, Soil Mechanics and Foundations Division

2:30 French Grouting Practices

A. MAYER, M. ASCE, Centre d'Etudes et de Recherches de l'Industrie des Liantes Hydrauliques, Paris, France.

3:15 Discussion

3:30 Use of Admixtures in Cement Grout Mixtures and Methods of Evaluating Their Contribution to Grout Qualities

A. KLEIN, M. ASCE, Research and Senior Engr., Univ. of Calif., Berkeley, Calif.

4:00 Discussion

4:15 Experience of TVA with Clay-Cement and Related Grouts

G. K. LEONARD, M. ASCE, Chief Construction Engr., TVA, Knoxville, Tenn.

4:45 Discussion

STRUCTURAL DIVISION FIELD TRIP

1:00 p.m. **Thursday, Oct. 18**

Trip: Visit to the largest steel fabricating plant in the world, located at Ambridge. This plant is fabricating such monumental structures as the Mackinac Straits and Carquinez Straits bridges. Plant of American Bridge Div., U. S. Steel Corp.

Transportation: By bus.

Departure: 1:00 p.m. from Penn-Sheraton Hotel.

Return: 5:00 p.m. to Penn-Sheraton Hotel.

Cost: No charge. Bus transportation furnished through courtesy of American Bridge Div., U. S. Steel Corp.

Registration: At Convention registration desk not later than 2:00 p.m. Wednesday, Oct. 17.

STUDENT CHAPTER CONFERENCE FIELD TRIPS

Thursday, Oct. 18

2:15 p.m.

In charge: F. A. Richards, J.M. ASCE, Research Engr., National Supply Co., Pittsburgh, Pa.

Tour 1

U. S. Steel Corp. Research Center, Monroeville, Pa.

Leave Penn-Sheraton Hotel, Grant Street Entrance, at 2:15 p.m.

This trip will consist of small intimate groups each with a guide to tour the U. S. Steel Research Laboratory. The laboratory is one of the largest in the area and does applied research in all phases of steel production. Some of the sights will be: high-temperature creep rupture of steel alloys; electronic instrumentation and control of steel production; atmospheric and chemical corrosion of steel; X-ray and spectroscopic analysis of gases for by-products; pilot lines of continuous steel rolling. The Research Laboratory is located in Monroeville, Penn., approximately 15 miles east of Pittsburgh.

Tour will be open to all ASCE members, guests and ladies, to a maximum of 275 people. Price per person, $1.25.

Tour 2

Jones & Laughlin South Side Works, Pittsburgh, Pa.

Leave Penn-Sheraton Hotel, Mellon Square Entrance, at 2:15 p.m.

This tour of the Jones & Laughlin Steel Corp.'s South Side Works will include an inspection of their new open-hearth shop and blooming mill. In the open-hearth shop, visitors will see the liquified steel as carbon and other impurities are boiled out into a slag and removed. In the blooming mill, visitors will see the initial process in the forming of structural shapes.

The tour will be open to all ASCE members, guests, and ladies. Price per person, $1.25.

Tour 3

Highlights of Pittsburgh's Redevelopment

Leave Penn-Sheraton Hotel, Mellon Square Entrance, at 2:30 p.m.

A bus tour covering outstanding projects in Pittsburgh is scheduled. The point of the Golden Triangle has undergone an extensive redevelopment with its state park and new buildings in beautiful Gateway Center. Several more modern buildings are under construction. Development of the lower hill district is moving along in the demolition of heavily inhabited areas. Plans have been made for a huge all-seasonal civic arena and park there. Construction is proceeding also on the Allegheny County Sewage Treatment Plant, an intensive job which has been developed over many years. These projects will be inspected by all interested members.

The tour will be open to all ASCE members, guests, and ladies. Price per person, $1.25.

All tours will return to the Penn-Sheraton Hotel between 5:00 and 5:30 p.m.

UNIVERSITY OF ILLINOIS DINNER

Thursday, Oct. 18 **6:00 p.m.**

The University of Illinois Civil Engineering Alumni and their friends will meet for their 29th annual informal dinner. A private dining room has been reserved at the William Penn Hotel. Ladies are invited. Dinner will be over in time to permit attendance at the ASCE Smoker. Reservations should be made as early as possible through Dr. F. T. Mavis, Carnegie Inst. of Technology, Schenley Park, Pa. (phone Mayflower 1-2600).

MEN'S SMOKER AND SHOW

Thursday, Oct. 18

8:00 p.m. **Ballroom**

This is your night out, men. The ladies will be entertained elsewhere and kept out until late.

You will be out with the fellows, your best chance to get together with old friends and make new ones. Everything informal and the way you want it. Beer and snacks free at your table. Bar service if you want it.

Important: There will be special entertainment throughout most of the evening, but the main show won't start until 9:00, so those who may have to come late will not miss it. And we have been promised a show you will not want to miss.

Then, after you have laughed too much and applauded too hard, sandwiches and coffee will be served to pick you up again.

$4.00 covers everything.

FRIDAY MORNING

OCT. 19

City Planning Division

9:30 a.m. **Allegheny Room**

The Future of Our Cities

Presiding: J. Cal Callahan, Member, Executive Committee, City Planning Division

9:45 Our Cities in Transition

HON. FRANK P. ZEIDLER, Mayor, City of Milwaukee, Milwaukee, Wis.

10:35 The Threat and Promise of the Atomic Age

11:25 Our Heritage and Our Future

MARTIN A. WHITTAKER, President, Lehigh Univ. Bethlehem, Pa.; Member, Penn. State Planning Commission.

Hydraulics Division

9:30 a.m. **Monongahela Room**

Cavitation in Hydraulic Structures

Presiding: Wallace M. Lansford, Vice Chairman, Executive Committee, Hydraulics Division; and Frank B. Campbell, Vice Chairman, Committee on Research

9:30 Introductory Remarks

FRED R. BROWN, M. ASCE, Chairman, Task Force on Cavitation in Hydraulic Structures, Chief Hydrodynamics Branch, Waterways Experiment Station, Vicksburg, Miss.

9:45 Cavitation Experiences of the Corps of Engineers

J. H. DOUMA, A.M. ASCE, Hydraulic Engr., Structures Branch, Office, Chief of Engineers, Washington, D. C.

10:30 Cavitation Experiences of the TVA

R. A. ELDER, M. ASCE, Hydraulic Engr. and Director, TVA Hydraulic Laboratory, TVA, Norris, Tenn.

11:15 Cavitation Damage to Roughened Concrete Surfaces

DONALD COLGATE, A.M. ASCE, Hydraulic Engr., U. S. Bur. of Reclamation, Denver, Colo.

Soil Mechanics and Foundations Division

9:30 a.m. **Urban Room**

Presiding: J. O. Osterberg, Secretary, Executive Committee, Soil Mechanics and Foundations Division

9:30 Measurements of Earth Pressure Against Bracing of Inland Steel Building Excavation, Chicago

Y. H. LACROIX, J.M. ASCE, Engr., Spencer, White & Prentis, Inc., and Research Asst., Univ. of Illinois, Urbana, Ill.

10:00 Discussion

10:15 Design of a Recharge System of Well Points

J. D. PARSONS, M. ASCE, Assoc. Partner, Moran, Proctor, Mueser, and Rutledge, New York, N. Y.

10:45 Discussion

11:00 Evaluation of Theories for Sand Drains

F. E. RICHART, JR., A.M. ASCE, Assoc. Prof. of Civil Eng., Univ. of Florida, Gainesville, Fla.

11:45 Discussion

FACULTY ADVISERS' CONFERENCE

Friday, Oct. 19

9:00 a.m.

Presiding: C. Russell Dole, member for the Middle Atlantic Region, Committee on Student Chapters

Faculty Advisers of 22 ASCE Student Chapters in Michigan, Indiana, Ohio, Pennsylvania, West Virginia, and Kentucky will convene upon invitation to discuss Chapter activities.

This all-day conference, while primarily for Faculty Advisers, is open to any and all who may be interested in Society activities in behalf of civil engineering students.

HIGHWAY AND CONSTRUCTION DIVISIONS FIELD TRIP

Friday, Oct. 19

9:00 a.m.

Trip: To tour sections of the Penn-Lincoln Parkway, limited-access expressway. Considered to be the most complicated expressway being built in an urban area in the United States.

Travel: By bus from hotel.

Departure: 9:00 a.m. from Penn-Sheraton Hotel.

Return: 12:00 noon to Penn-Sheraton Hotel.

Cost: For bus, no charge, courtesy of Portland Cement Assoc.

Registration: At Convention registration desk not later than noon Thursday, Oct. 18.

FRIDAY AFTERNOON

OCT. 19

City Planning Division

2:30 p.m. **Allegheny Room**

The Future of Our Cities *(continued)*

Presiding: J. Cal Callahan, Member, Executive Committee, City Planning Division

Panel Discussion and Open Forum

Hydraulics Division

2:30 p.m. **Monongahela Room**

Hydraulic Subjects

Presiding: Wallace M. Lansford, Vice Chairman, Executive Committee, Hydraulics Division, and Professor J. M. Robertson, Past Chairman, Committee on Research

2:30 Flow Control

VICTOR L. STREETER, M. ASCE, Prof. of Hydraulics, Univ. of Michigan, Ann Arbor, Mich.

3:15 Dike Arrangement to Reduce Scour Potential of Bridges

J. C. GUILLOU, J.M. ASCE, Research Assoc. Prof. of Hydraulic Eng., Univ. of Illinois, Urbana, Ill.

4:00 The Garfield Thomas Water Tunnel Research Facility

A. F. LEHMAN, Project Engr. for Water Tunnel Operations, Ordnance Research Lab., The Penn. State Univ., University Park, Pa.

WATERWAYS AND HARBORS DIVISION BOAT TRIP

Friday, Oct. 19

1:30 p.m.

Trip: River tour will include a view of the Pittsburgh district industrial complex, the spectacular redevelopment in the Golden Triangle area, and recent river improvements.

Travel: Bus from Hotel Penn-Sheraton to wharf at Fort Duquesne Blvd. and 6th Street and return. Charge, 50¢ per person.

Boat Ride: Furnished through courtesy of Dravo Corp. Refreshments will be served. No charge.

Departure: 1:30 p.m. from Penn-Sheraton Hotel.

Return: 4:30 p.m. to Penn-Sheraton Hotel.

Registration: At Convention registration desk not later than 5:00 p.m., Thursday, Oct. 18.

SESSIONS OF BOARD

The ASCE Board of Direction will be in session at the following times:

Monday, Oct. 15: 9:30 a.m. to 5:00 p.m.

Tuesday, Oct. 16: 9:30 a.m. to 5:00 p.m.

Thursday, Oct. 18: 2:30 p.m.

INFORMATION AND REGISTRATION

Information and registration facilities will be maintained on the 17th floor of the Penn-Sheraton throughout the days of the Convention. Mail and messages will be held for members at the Information Desk.

PRESS ROOM

For the convenience of the technical press, newspapers, radio and television, a press room will be open throughout the days of the Convention in the Penn-Sheraton Hotel.

LADIES' PROGRAM

Because Pittsburgh has had so much publicity in recent years, we hope that many of the ASCE wives have a real interest in our city. We have planned to take you to Oakland, our civic and cultural center; to Longue Vue, which is a lovely country club above the Allegheny River about eight miles from town; and to Mt. Washington for a birdseye view of the three rivers on which we are having the boat trip.

Monday, Oct. 15

1:00 p.m.

Luncheon at the University Club and a visit to the University of Pittsburgh's "Cathedral of Learning" with its interesting and unique Nationality Rooms and the beautiful Heinz Chapel. Tickets, $3.00.

Tuesday, Oct. 16

Busses will leave the hotel at 11:30 a.m. for Longue Vue Country Club. Music and fun after the luncheon. Return to the hotel by 4:30 p.m. Please get tickets on Monday. Tickets, $4.00.

Wednesday, Oct. 17

"Seven Wonders of the World," the third Lowell Thomas Cinerama, is being shown at the Warner. This theater is a short walk from the hotel. Tickets for the matinee at two o'clock will be on sale on the 17th floor until 10:00 a.m. Tickets, $1.60.

Thursday, Oct. 18

A boat trip on our three rivers with luncheon served on board. En route to the dock the busses will stop for a view of the city and the rivers from the heights of Mt. Washington. Busses will leave the Penn-Sheraton at 11:30 a.m. No charge.

There are also Student Tours this afternoon which are available to the ladies.

LADIES HOSPITATLITY ROOM

Parlor G **17th Floor**

The Hospitality Room will be the place to meet other ladies attending the Convention. It will be open from 2 to 4 on Sunday, and from 9 to 5 Monday through Thursday. You will find hostesses to answer questions and help with problems. We shall serve coffee each morning from 9:00 to 10:30.

ANNUAL CONVENTION COMMITTEES

Park H. Martin, *General Chairman*
F. T. Mavis, *Vice Chairman*
Robert B. Pease, *Secretary*
Donovan E. Oelschlager, *Treasurer*
William A. Conwel
Charles M. Wellons

Entertainment

Frank C. Sturges, *Chairman;* I. E. Madsen, Henry Rockwood, Robert M. Morris, Henry J. Larsen.

Excursions

M. A. Gross, *Chairman;* F. R. Stocker, C. F. Peck, Jr., E. J. Staubitz, Marshall Holt, Robert L. Horne, Frederick H. Dill, Fred J. Jernberg.

Finance

Don C. Peters, *Chairman;* Gerald G. Greulich, J. E. Jackson, Byron E. Rhoads, Robert L. Horne, Daniel E. Davis, Donovan E. Oelschlager, *ex officio.*

Hotel Arrangements

Herbert J. Dunsmore, *Chairman;* John O. Cook, Alvin W. Bartz, James H. Morehouse, Maurice A. Shapiro, William G. Logan.

Publicity

William R. B. Froehlich, *Chairman;* Merritt A. Neale, John W. Graham, Jr., Charles A. Keelen, Arnold A. Zimmer.

Reception

Eugene N. Hunting, *Chairman;* A. C. Ackenheil, Sr., D. J. Camilli, C. Edward Long, Howard H. Sturdy, James P. Growdon, Thomas B. Sturges, Donald L. Sommerville, H. P. McKown.

Registration and Information

John E. Heinzerling, *Chairman;* Norbert L. Ackermann, Joseph F. Artuso, Thomas J. Crowley, Walter T. Florence, Jr., Samuel R. Harper, Jr., Roy F. Johns, John R. Jombock, Robert B. Kosan, Sara-ann Lance, Italo V. Mackin, John J. Mathison, Jr., Archie J. Merritt, Thad Pyedrowski, Sherwood Richardson.

Student Activities

John W. Graham, Jr., *Chairman;* A. C. Ackenheil, Jr., Raymond W. Bukauskas, Kenneth I. Fetterhof, James Romualdi, Fred A. Richards, Donald L. Tanner.

Technical Program

Carl B. Jansen, *Chairman;* Wilfred Baukknight, *Vice Chairman;* I. E. Madsen, *Secretary;* R. W. Jordan, *Ass't Secretary;* Edward G. Messner, Patrick J. Cusick, Jr., Jacque S. Minnotte, Elio D'Appolonia, James W. McKnight, Thomas E. Stelson, R. B. Horner, Daniel E. Davis, A. C. Ackenheil, Jr., Arthur S. Marvin, George A. Guyer, Charles M. Wellons, Myron G. Mansfield.

Transportation

Donald M. McNeil, *Chairman;* Michael J. Gittens, Paul N. Gustafson, Samuel E. Bittner, Jr., Cecil H. Barrett, Alfred Mengato, Emil P. Schuleen, Gilbert P. Fleetwood, John P. Frazier.

Women's Activities

Mrs. George S. Richardson, *Chairman;* Mrs. Park H. Martin, *Co-Chairman;* Mrs. A. C. Ackenheil, Jr., Mrs. W. A. Baukknight, Mrs. W. A. Conwell, Mrs. Elio D'Appolonia, Mrs. J. P. Frazier, Mrs. G. G. Greulich, Mrs. J. E. Heinzerling, Mrs. Carl B. Jansen, Mrs. C. A. Keelen, Mrs. F. T. Mavis, Mrs. J. H. Morehouse, Mrs. R. B. Pease, Mrs. E. R. Peters, Mrs. D. L. Sommerville.

SOCIETY NEWS

Last Call for ASCE Annual Convention

There is still time to make your plans to attend the Society's Annual Convention, to be held in Pittsburgh, October 15–19, with the Pittsburgh Section as host. The shift to Pittsburgh means that, in addition to the usual challenging Annual Convention program, there will be the stimulus of a new background for the impressive calendar of events. Engineers, of all people, should be interested in seeing for themselves what proper planning and large-scale engineering have been able to accomplish in a short time in making Pittsburgh the proud city it is today. Some of the dramatic changes, ranging from a successful ten-year fight against smoke and smog to the tremendous new highway development program centering about the Penn-Lincoln Parkway, were discussed briefly in the Convention stories in the July and August issues. Papers on most of the important new Pittsburgh projects will be read at the meeting.

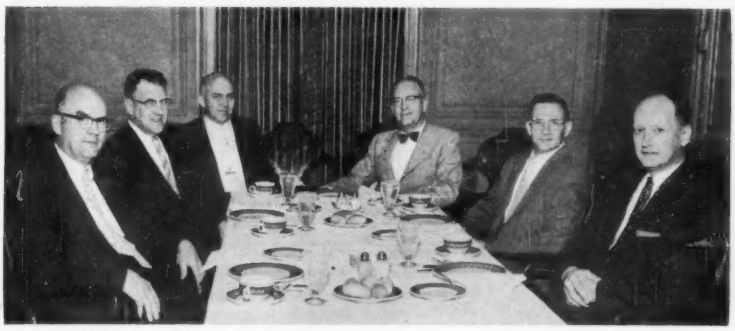
In all there will be forty-three technical sessions, sponsored by all thirteen Technical Divisions. Interesting programs have also been arranged for four luncheons, three of which will be joint Division affairs. The Monday luncheon will be sponsored by the Engineering Mechanics, Sanitary, and Structural Divisions, with Carroll V. Rosebury as the speaker. Maj. Gen. Emerson Itschner, newly appointed Chief of Engineers, will address a Tuesday luncheon under sponsorship of the Construction, Hydraulics, and Waterways Divisions. On Wednesday I. W. Wilson, president of the Aluminum Company of America, will address a luncheon of the Committee on Conditions of Practice. The third joint luncheon, to be held Thursday by the Highways, Soil Mechanics, and Surveying and Mapping Divisions, will have Rex M. Whitton, chief engineer of the Missouri State Highway Commission, as speaker. The entire Convention program of technical and social events is printed elsewhere in this issue.

Highway Division Sessions

Challenging problems, which will face engineers, designers, city planners, municipal officials, contractors, and others in carrying forward the national highway program, will be the focus of attention in the Highway Division sessions. Highway activities for many years to come will revolve around the expanded road program. The timely issues—technical, administrative, and legal—to be explored in four Convention sessions will thus be matters of continuing interest and importance, and a record-breaking attendance is expected. Special field trips to visit parts of Pittsburgh's famous redevelopment plan will help show the strategic role of highways in urban renewal.

Under the broad theme, "Expressway Problems Unlimited," two of the sessions will deal with basic questions and emerging concepts involved in limited-access design for safe and uninterrupted high-speed highway transportation. Engineering management, administrative controls, traffic prediction problems, and pertinent legislative and legal aspects will be featured in one symposium. Another symposium will deal with the development of expressway plans and specifications and problems of maintaining uninterrupted operation on limited-access facilities. Keynote of another session will be "Highways in the Pittsburgh Renaissance."

The highway experts presenting papers in these sessions are listed in the program.



Pittsburgh Section members meet at luncheon to cope with problem of coordinating the tremendous technical program planned for the Society's Annual Convention, to be held in Pittsburgh in October. Left to right are H. J. Dunsmore, I. E. Madsen, Wilfred Bauknight, Carl B. Jansen, R. W. Jordan, and W. R. B. Froehlich. Mr. Jansen is chairman of the Technical Program Committee, which will present 43 sessions. Mr. Froehlich is chairman of the Publicity Committee.

Mexico City to Be Host to Fourth UPADI Convention

Fascinating Mexico City will be the locale of the fourth convention of the Pan-American Federation of Engineering Societies (UPADI), which will meet there October 8 through 12. Engineers from the United States, Canada, and Latin America are expected to attend. Host to the group will be the Unión Mexicana de Asociaciones de Ingenieros.

James M. Todd of New Orleans, past-president of the ASME, will head the United States delegation. Vice-chairman of the delegation will be ASCE Past-President Gail A. Hathaway, who is also present chairman of the EJC Committee on International Relations. The delegation will also include Enoch R. Needles, President of ASCE; J. W. Barker, president of ASME; ASCE Past-President Carlton S. Proctor; Louis R. Howson Vice-President of ASCE; William H. Wisely, Executive Secretary of ASCE; William N. Carey, Secretary emeritus of ASCE; C. E. Davies, secretary of ASME; and A. J. Ackerman, George E. Brandow, and Stewart E. Reimel, Members ASCE.

While the convention will be primarily a business meeting, committee sessions

will provide opportunities to exchange information and ideas. In addition, there will be a series of round tables on particular subjects—engineering education, for one—with engineers from various nations taking part.

Of special importance is the decision to hold a meeting of the Pan-American Standards Committee in conjunction with the UPADI Convention. Standards organizations in Argentina, Chile, Mexico, Brazil, Uruguay, and the United States have indicated a desire to have such a meeting, the purpose of which will be to organize a Pan American standards movement.

Engineers who would like to attend the convention in Mexico City or who would like more information on UPADI should communicate with Brig. Gen. S. E. Reimel, Committee on International Relations, EJC, 29 West 39th Street, New York, N.Y.

Topic for New Daniel Mead Contest Announced

As announced in the report of the Board of Direction actions at Knoxville (July issue, page 72), the subject for the 1957 Daniel W. Mead Prize competition has been approved. This year both Junior Members and Students will write on the topic, "Under What Conditions Should Faculty Members Engage in Outside Professional Engineering Practice?" The prizes, which were established in 1939 by the late Daniel W. Mead, Past-President and Honorary Member of ASCE, consist of $100 and $50, respectively, and certificates.

All papers intended for entry in the competition should be in the hands of the Executive Secretary of ASCE not later than May 1, 1957. This is not as far in the future as it seems, when it is remembered that each essay must first be presented before a Local Section or Student Chapter. A full description of the rules is given on page 134 of the 1956 Official Register. Reprint copies will be sent on request.

ASCE MEMBERSHIP AS OF AUGUST 9, 1956

Members	9,284
Associate Members	12,149
Junior Members	17,927
Affiliates	72
Honorary Members	41
Total	39,473
(Last Aug. 9	38,737)

ASCE Urges Selection of Experienced Federal Highway Administrator

In the days when the pros and cons of the highway bill were being debated in Congress, a special ASCE Task Committee on the National Highway Program appeared before congressional committees and supplied them with pertinent information. With the bill enacted into law, the Society on July 30 sent a telegram to President Eisenhower, urging that the newly created post of Federal Highway Administrator be filled by a "fully qualified administrator." Copies of the telegram were also dispatched to Secretary of Commerce Sinclair Weeks; Senator Dennis Chavez; Charles Curtiss, commissioner of the Bureau of Public Roads; Alfred E. Johnson, executive secretary of the American Association of State Highway Officials; and J. P. Buckley, secretary of the Executive Committee of the ASCE Highway Division.

The telegram, which was signed by President Needles, assured the President of the Society's "deep interest" in the legislation authorizing appointment of a Federal Highway Administrator. The telegram continues, "In view of the tremendous importance of this engineering program to the economy, national defense, and safety of traffic, which you have so ably pointed out on several occasions, it is essential that a fully qualified administrator be given this responsibility. Capable non-partisan management is indispensable to efficient utilization of the billions of dollars of federal-aid funds authorized."

In concluding it draws attention to the opinion of the Senate Committee on Public Works, "that the man appointed 'should be of real competence, experienced in highway matters,'" and also that he 'must have engineering supervisory and administrative personnel of the highest caliber to assist him.'"

In a letter dated July 31, Secretary Weeks assured the Society that its recommendation "will be given every consideration when the appointment is made." Robert Gray, Special Assistant to President Eisenhower, wrote on August 6, conveying the President's thanks for the Society's expression of its views and concluding "you may be sure that they will be borne in mind."

Acting directly under the Secretary of Commerce, the new Federal Highway Administrator will be responsible for dealing with the state highway departments and determining the rules under which the thirteen-year highway program will be administered. While the Commissioner of Public Roads will continue in charge of the Bureau's technical operations, policy decisions previously made by the Bureau will be made by the new official.

Second Nuclear Congress Slated for Philadelphia

On the agenda for early in 1957 is a Second EJC Nuclear Engineering and Science Congress and accompanying Atomic Exposition, which will be held at the Convention Hall in Philadelphia, March 11–15. Like the first Congress, which was held in Cleveland in December 1955, the forthcoming event will be coordinated by Engineers Joint Council.

With nineteen major engineering and scientific societies already planning to participate in the Congress, it is expected that the attendance will top the 3,000 engineers and scientists attending the Cleveland Congress. It is also expected that the Atomic Exposition, which will display the latest peacetime developments in the application of nuclear energy, will draw an even larger audience than the 13,000, who saw the Cleveland exhibits. There will be a greater number of exhibitors in the Exposition, reflecting the developments in nuclear energy and allied fields that have come into being in the fourteen months since the last congress.

Walter G. Whitman, who was chairman of the United States delegation to the 1955 Geneva Conference on Atomic Energy and head of the chemical engineering department at Massachusetts Institute of Technology, has been named chairman of the General Committee for the Congress. Chairman of the Program Committee is Bruce R. Prentice, of the General Electric Company, Schenectady, N.Y., and a member of the EJC Panel on Atomic Energy. The Atomic Exposition will be sponsored by the AIChE and will be under the management of Denham & Company, Detroit, Mich.

ASCE to Have Exhibit During Annual Convention

ASCE is making plans for its first commercial exhibit in connection with a Society Convention. A Civil Engineering Show, complementing the technical program, will be held at the Annual Convention at the Hotel Statler in New York, October 14–18, 1957. The Board of Direction has voted that exhibitors may include any company producing materials or manufacturing equipment or providing services used or specified by civil engineers, subject to conditions that will be announced later.

The new activity will not reduce in any degree the traditional concentration on the technical program. Rather it is believed the exhibit will be a valuable adjunct to the technical sessions.

Personnel Problems Studied by E.S.P.S. Board of Directors

© *Rose Photos*

Members of board of directors and branch office managers of Engineering Societies Personnel Service, Inc., have joint meeting in New York late in July for discussion of operating procedures. During the two-day study the Chicago office revealed that it is finishing conversion to plan in which employer will pay entire fee. It was the consensus of the group that this is the ideal time for persons seeking new or better employment to register. Attendance included (left to right, seated) E. Kirkendall, secretary AIME; C. E. Davies, secretary ASME; N. Hibshman, secretary, AIEE; A. H. Meyer, executive director, E.S.P.S.; and W. H. Wisely, Executive Secretary ASCE. Standing, in same order, are R. Gardner, AIEE; B. Allen, manager, Chicago office; G. Parker, manager, New York office; J. Decker, manager San Francisco office; O. B. Schier, II, ASME; E. J. Kennedy, AIME; P. Apol, AIME; J. A. Zecca, ASCE; E. Hartford, ASME; and F. McKinless, manager, Detroit.

Vault of Future Honors C. H. Tompkins, M. ASCE

Here Bernard F. Locraft, president of National Capital Section, places box for ASCE in connection with dedication of a Vault for the Future in honor of Charles H. Tompkins, Washington builder and member of board of trustees of George Washington University. Ceremonies took place in front of the Tompkins Hall of Engineering, George Washington University, on June 20. ASCE Past-President Carlton S. Proctor was featured speaker at the dedication of the vault in honor of Mr. Tompkins, who is a veteran member of the National Capital Section.

Coming Events

Illinois—Fortieth Anniversary Celebration Banquet in the new George Bernard Shaw Room of the Sherman Hotel, Chicago, October 11. Social and cocktail hour at 5:30 p.m.; dinner at 7:00. Program will include special entertainment and dancing. Tickets $6.50 per person ($5.00 for Junior Members and students). Raymond S. Knapp is chairman of the Anniversary Dinner Committee.

Kansas—Sanitary Engineering Conference at the Continental Hotel, Kansas City, Mo., November 19 and 20. Inquiries to Glenn C. Gray, Chairman, Subcommittee on Publicity, Larkin and Associates, Consulting Engineers, 19 East Gregory Blvd., Kansas City 14, Mo.

Maine—Joint meeting with the New Hampshire and Vermont Branches to be held at Littleton, N. H., on October 6. Tentatively the program will include a tour of Littleton Dam.

Metropolitan—Meeting in the Engineering Societies Building, September 19, at 7:00 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Texas—Fall meeting at Austin, October 4–6, with the Austin Branch as host. Program will include a panel discussion on the peaceful uses of atomic energy; the first conference for officers of the Section's thirteen Branches; a luncheon featuring a talk by President Needles; and Saturday morning breakfast with Student Chapters members as guests.

Scheduled ASCE Conventions

PITTSBURGH CONVENTION
Pittsburgh, Pa.
Penn-Sheraton Hotel
October 15–19, 1956

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

BUFFALO CONVENTION
Hotel Statler
June 3–7, 1957

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

On August 11 members of the **Arizona Section** enjoyed an all-day motorcade to scenic spots in the Flagstaff area. On the tour were famous sunset Crater and the lava beds and ice caves. The 70-mile trip took the group over Shultz Pass Drive and Fort Valley Highway, with a stop at Little Springs in the deep forest for luncheon. Following the trip there was a business meeting. The pleasant program was arranged at the last moment by Vic Householder, when it was found necessary to abandon a long-planned logging train trip into the forests of the Southwest Lumber Mills at Flagstaff because of the shortage of logging locomotives.

The **Brazil Section** installed its new officers at a social meeting held in Sao Paulo on July 15. The slate is Odair Grillo, president; Mario Savelli, vice-president; Henrique B. Cavalcanti, secretary; and Nelson B. Camargo, treasurer.

In the **Delaware Section** the new slate is Ernest S. VanDemark, president; James D. Wilson, vice-president; and Horace L. Lefferts, secretary-treasurer.

The charge that the Society is an "Old Man's Club" is well challenged by Junior Member Gordon Dalrymple, secretary of the **Georgia Section,** in comments on the Knoxville Local Section Conference in the Section's June-July newsletter. Said the young secretary, "The average age of the delegates was about 37 years . . . These delegates were the spokesmen for members, both old and young . . . .They typify to me the stamina and purpose given to the Society in recent years through the initiation of a program integrating Junior Members into positions of social responsibility . . . .The challenge has been placed before us. Do we accept it or shall we remain content with the attitude of so many—What can or does the Society do for *me*? If this is your attitude, the answer can only be—just as much as *you* do for the Society."

One of the Civil Engineering Wonders, the Chicago Sanitary System, was inspected by thirty members of the **Illinois Section** following one of the regular Friday noon luncheon meetings. J. M. Mercer, assistant civil engineer of the Chicago Sanitary District, briefed the group, which then toured the West-Southwest treatment plant, newest and largest in the District. Chicago's sewage disposal system includes 244 miles of intercepting sewers; three treatment plants with a capacity of 1,100 mgd; and canals, locks, and waterways diverting 1,500 cfs of Lake Michigan water through the Chicago River to the Mississippi drainage basin. Raymond S. Knapp heads the Anniversary Dinner Committee, which is planning the Section's "social event of the year," a gala dinner and program to celebrate the founding of the Section back in 1916 (see "Coming Events").

Kansas Section President Dwight Metzler reports in a recent Section newsletter that interest in and enthusiasm for Section activities are at a record high. Meeting attendance is well above average, and there are more dues-paying members than ever before. President Needles was featured speaker at a recent meeting, which was open to the ladies of the Section. The first meeting of the fall will be held at Wichita, where there is talk of forming a Branch.

Addressing the **Maine Section's** sixth anniversary meeting, held at Pemaquid, on August 4, ASCE President Enoch R. Needles discussed the effect of the national highway program on the engineering profession. The task of engineering the new program was compared to that at the outset of World War II, which produced legendary feats on the part of the engineer. Expressing his confidence that the burden of engineering the program will be adequately met, Mr. Needles pointed out that the caliber of today's engineers is being increased by higher college entrance requirements and better instruction. New engineering methods, design techniques, and electronic computing equipment are expected to increase the output of the engineer. In return for his important services, Mr. Needles said, the engineer must be compensated in accordance with his ability and his role in the undertaking, which will be the largest peacetime project in the history of the country. To this end, 29 states have already adopted a salary scale recommended by the American Association of State Highway officials before passage of the bill.

The **Metropolitan Section's Junior Member Forum** is starting the new season with a new slate of officers: Joseph S. Ward, president; Louis J. Capozzoli, Jr., first vice-president; Harry P. Rode, Jr., second vice-president; C. Richard Walter, secretary; and Milton Alpern, treasurer. Committees will be headed by Daniel Koffler, Program; Howard Grill, Public Relations; J. M. De Salvo, Status; Charles R. Heidengren, Membership; Frank Brennan, Technical Seminars; Robert J. Spinna, Education; Harry Morgan, Arrangements; and Donald Kowtko, Reception.

Maine Section celebrated its sixth anniversary on August 4 with outing and meeting at Gilbert's Lobster Pound, Pemaquid. Prominent among the 77 attending are (left to right) Charles O. Dawson, president, New Hampshire Branch; Frank A. Marston, ASCE Vice-President, Zone I; ASCE President Enoch R. Needles; Charles F. Parker, president, Maine Section; Albert Haertlein, newly elected Honorary Member and former Director and Vice-President; and Louis M. Laushey, president Vermont Branch. In featured address (elsewhere on this page) President Needles discussed new highway program and its probable effect on the profession.

The **Mexico Section** has established an annual Junior Membership award for graduating civil engineers from the University of Mexico. The award, consisting of the payment of the entrance fee, first year's dues, and badge, will be made on the basis of the best graduation thesis. At a recent meeting Junior Member Leopoldo Lieberman, technical director of Planificacion y Construccion, S.A., spoke on design and construction of the Chihuahua cellulose plant. The plant is a good example of modern Mexican industrial design, and the largest of its kind in the country, with an annual capacity of 50,000 tons. Raymond F. Dawson, ASCE Director for District 15, was guest of honor and featured speaker at another recent Section meeting—a dinner meeting held at the home of Vice-President Leopoldo Farias. Another distinguished guest was Prof. Adelbert Diefendorf, dean of the engineering school at the University of Utah. Professor Diefendorf is giving a course on highway engineering at the University of Mexico this summer. The course was promoted and organized by the Section.

A tour of the Mississippi Power and Light Company's Rex Brown Steam Plant occupied members of the **Jackson Branch** of the **Mid-South Section** on a recent summer evening. Preceding inspection of the plant, the company was dinner host to the group and members of its engineering staff explained the project. The Branch unanimously passed a resolution honoring its veteran member and former officer, Ben T. Collier, on his retirement as president of the Mississippi State Board of Registration for Professional Engineers. The Branch has also written to the Hon. J. P. Coleman, governor of Mississippi, commending him for his appointment of two other members —Sydney W. Chandler and Boyce H. Biggers—to the State Board of Registration. Recent programs of the **Little Rock Branch** have featured talks by Harold Wenzel, regional structural engineer for the Portland Cement Association at Atlanta, Ga., who discussed the use of prestressed bridge and building members in the Southeast; Fred Herring, chief of the Statistics and Analysis Division of the Arkansas State Highway Department, who described the set-up and operation of the department; and Vealess Hudspeth, junior traffic engineer for the Arkansas Highway Department, who presented some of the problems involved in traffic engineering and possible solutions to them. Up for discussion at a recent meeting of the **Vicksburg Branch** was the Army's Scientific and Professional Personnel Program, set up to utilize the talents of drafted professionals. The employee's side of the program was described by Pfc J. D. Decker, currently stationed at the Waterways Experiment Station. Col. A. P. Rollins, director of the Station, discussed the program from the standpoint of the using agency.

(Continued on page 92)

Maj. Gen. William E. Potter, new governor of Canal Zone, was guest of honor and principal speaker at July 30 meeting of Panama Section, held at Tivoli Guest House, Ancon. Speaking on the subject, "First Impressions," Governor Potter told the group that Canal Zone residents have a tendency to look too much within and to concentrate on their own problems to the exclusion of interest in the really big problems that have a lasting impact on the American way of life. He was introduced by Col. Hugh M. Arnold, engineering and construction director of the Panama Canal Company and president of the Panama Section. Shown here, in usual order, are Mrs. Arnold, Governor Potter, Mrs. Potter, Celso Carbonnell, first vice-president of Panama Section; and Mrs. Nelson E. Wise.

In Syracuse Section new St. Lawrence Branch has been formed, with headquarters at Massena, N. Y., site of St. Lawrence Seaway and Power Project. At a recent organizational meeting, first officers were elected. Pictured, left to right, are Sidney N. Smith, Organizational Committee; Richard E. Burnett, Organizational Committee; Judson P. Elston, vice-president; Luther E. Cliffe, president; Gerald R. Leach, secretary-treasurer; and Ellis L. Armstrong, director and member of Organizational Committee. Photo courtesy of New York State Power Authority.

Executive Secretary Wisely attends dinner meeting of Venezuelan Section in Caracas during his tour of Latin-American countries late in June (August issue, page 69). Shown at head table left to right, are Mr. Wisely; Mathias Brewer, Jr., engineer, Compania Anonima Brebe, Caracas; Section President E. J. Aguerrevere; Mrs. Wisely; Mrs. Brewer; Lloyd M. Shumaker, vice-president of the Section; and Secretary-Treasurer Santos Michelena. Local problems in sanitation were discussed at the meeting.

Honored at Awards Luncheon for University of Nebraska Student Chapter, held at end of school year, are (usual order, front row) Dean McNulty, honored for his contributions to Chapter work; Walter Linder, who received Warren B. Day Memorial Award for being top student scholastically and Barry Larson, recipient of Fulton Cramer Award for the best student paper. In back row are Faculty Adviser Bruce Meyer; Arthur A. George Fullerton, winner of Adna Dobson Award as the outstanding civil engineering senior and John Cramer, senior Contact Member.

The **New Mexico Section** has endorsed a State Plane Coordinate System for New Mexico. Walter Hall, chairman of the Section's Committee on State Plane Coordinate Systems, gives a history of the system in a recent issue of the Section's quarterly bulletin. Mr. Hall, with the assistance of Rowland Fife, presented the issue and stressed its importance to the state at a recent meeting of the New Mexico Engineering Council.

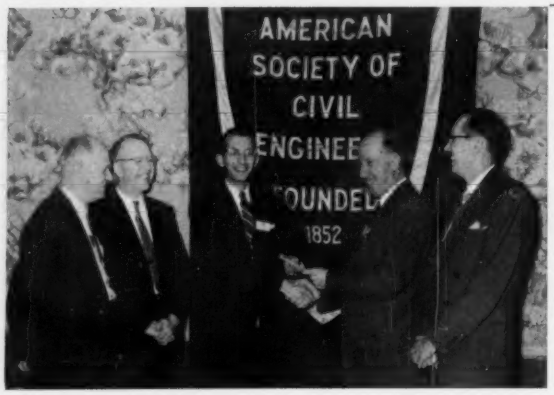
The Rhode Island Section (until recently the Providence Section) has unanimously elected new officers, who will take over in September when meetings resume. The 1957 slate will be Robert B. Strong, chairman; John Westman, vice-chairman; and Charles N. Bissell, secretary-treasurer.

Members of the **Sacramento Section** keep up their lively interest in Section affairs through the dog days. By August 14 they had reached their 1,650th luncheon meeting, at which Brig. Gen. William F. Cassidy, division engineer for the South Pacific Division of the Corps of Engineers, was featured speaker. General Cassidy's subject was the construction plans of the Corps. At the August 7 luncheon L. A. Hostetter, currently with the firm of Bleifuss, Greenwood and Hostetter, took the group on a quick trip around the world with some of the choicest of his color slides made on visits to 31 countries during eight years of employment with the International Engineering Co. At the helm of the **Junior Forum** for the next six months will be Robert U. Grant, president; Beverly H. Hoffmaster, vice-president; and Howard C. Miner, secretary-treasurer. The semi-annual election of officers took place in June.

In a recent outstanding program, members of the **San Diego Section** heard Comdr. Charles Merdinger, public works officer at the Miramar Naval Air Station, give "A New Slant on Engineering Education." Basing his talk on two years at Oxford University, where he received his engineering doctorate, Commander Merdinger contrasted technical teaching methods and standards in Europe with our own. A new slate of officers took over on July 1: George R. Saunders, president; C. A. Smith, Jr., first vice-president; B. C. Wilkas, second vice-president; W. D. Myers, secretary; and L. G. Jefferies, treasurer. Messrs. Myers and Jefferies were reelected.

As "a Boy Scout is trustworthy, so an engineer is precise," said the *Tacoma News Tribune* of July 8, in an unsolicited though not unwelcome write-up of the **Tacoma Section's** plans for its annual picnic and outing at Benbow Resort, Lake Tanwax, on July 14. Especially commended were the "strategically placed signs" that pointed the way to the picnic site from Seattle, Tacoma, and Olympia and the careful arrangements to solve the perennial picnic problem of "too much of this and not enough of that" in the food line. Credit for the perfect blueprint of a good picnic goes to Junior Members John A. Petteys, Jr., and William A. Bulley.

For their July meeting members of the **Texas Section's Fort Worth Branch** heard Dr. John J. Andujar speak on the need for new state legislation requiring a medical doctor to serve as coroner when a person dies without medical attention. Under present Texas law a Justice of the Peace is required to serve in this capacity.



Key persons in attendance at annual joint meeting of West Virginia Section and West Virginia University Student Chapter are (left to right) Prof. H. W. Speiden, head of the department of civil engineering; W. H. Baker, assistant professor of civil engineering; Frank T. Wheby, outstanding senior and winner of Section's annual award; Wilson Ward, vice-president of Section; and Chester A. Arents, dean of College of Engineering and guest speaker. In talk, entitled "The Civil Engineer's World," Dean Arents emphasized importance of engineers and scientists in modern industrial civilization.

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REINFORCED CONCRETE

From coast to coast, highway engineers are finding that reinforced concrete bridges start quicker because all necessary materials and labor are readily available from local sources. These faster starts, made possible with reinforced concrete, save months of delay.

Furthermore, reinforced concrete is a flexible medium that permits an infinite variety of imaginative and graceful designs. You can design multiple overpass bridges with bold, dramatic lines and soaring curves. Structures built with reinforced concrete are rugged . . . highly resistant to wind, shock, and quake. What's more, they are lower in first cost and require less maintenance.

On your next bridge or overpass, design for rugged beauty plus economy . . . design for REINFORCED CONCRETE.

all construction material available from local stocks

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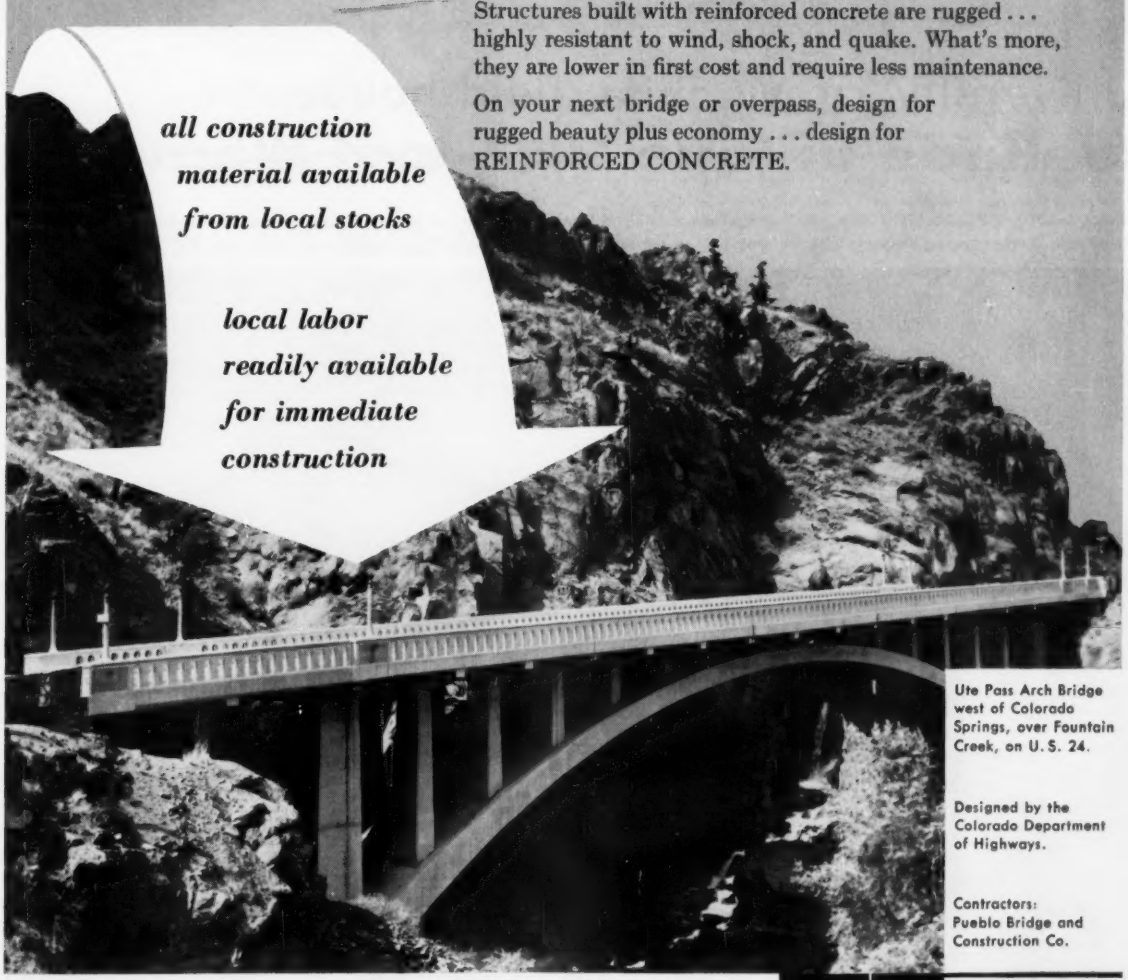

Ute Pass Arch Bridge west of Colorado Springs, over Fountain Creek, on U. S. 24.

Designed by the Colorado Department of Highways.

Contractors: Pueblo Bridge and Construction Co.

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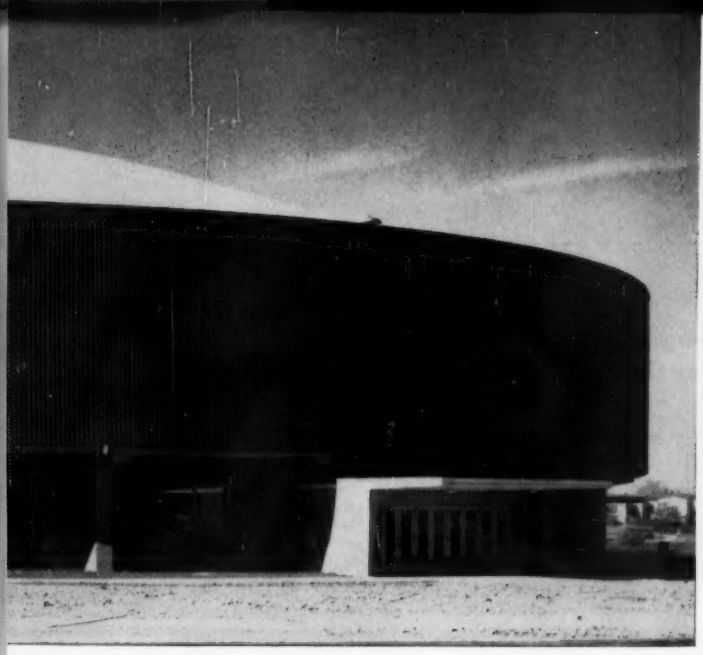
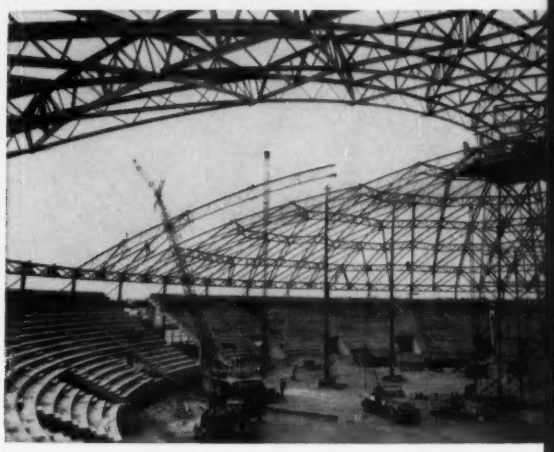
University of Wichita field house **features unique 267-foot diameter**

THE ALL-WELDED, EXPOSED STRUCTURAL STEEL framework actually enhances the attractive interior of the building. The soffits of all trusses are painted a brilliant red which contrasts with the gray lead of the rest of the steel, emphasizing the diamond pattern.



UNIVERSITY OF WICHITA FIELD HOUSE. Architects: Lorentz, Schmidt, McVay, and Peddie, Wichita, Kansas. **Steel Fabricator:** Watkins Inc., Wichita. **General Contractor:** Dondlinger and Sons Construction Company, Wichita. **Designer and Engineer of Lamella Roof Structure:** Roof Structure Inc., Webster Grove, Missouri.



THE ROOF STRUCTURE is supported by 36 10WF39 columns. A trussed ring girder, 39 inches deep, rests on top of the columns and runs the entire perimeter of the building. Into this ring girder are framed 12 radial trusses which span to the compression ring at the apex of the roof. Also springing from the ring girder at intermediate points are curved roof trusses which intersect the radial trusses, resulting in the characteristic diamond-shaped lamella pattern.

lamella dome of Structural Steel

432 tons of steel erected in only 14 days

The unique lamella dome of Structural Steel which crowns the University of Wichita's new field house is the *first* such dome ever to be constructed. It was designed, developed and put to use for two practical reasons—economy and speed of erection.

Spanning 65,000 square feet, the 432 tons of Structural Steel were erected by two crews in the spectacular time of just 14 days! Starting on opposite sides of the building, the two crews worked around in one direction until closure was effected. The only falsework required was a central tower supporting the compression ring, or "lantern," at the apex of the dome. All connections were bolted during erection, then field-welded.

Built at a total cost of $1,405,700, the ultra-efficient structure includes such features as a complete heating and ventilating system (with radiant heating in the locker rooms), and color-corrected vapor lighting for the arena. And, with peripheral seating, not one of the 10,235 seats is more than 86 feet from the playing surface.

Where economy, speed of erection, and dramatic design are the keywords of construction, that's where you'll find versatile Structural Steel. Moneywise, Structural Steel is the most economical of load-carrying materials. And, it's the strongest. It will withstand more abuse than other structural materials, effectively resisting tension, torsion, compression and shear. Once enclosed in buildings, it lasts indefinitely, requiring no maintenance.

USS STRUCTURAL STEEL

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Structural Steel may be riveted, bolted or welded, and may be erected in any weather. Since steel members are fabricated indoors, weather can have no effect on the quality of workmanship. Want more information? Return the attached coupon.

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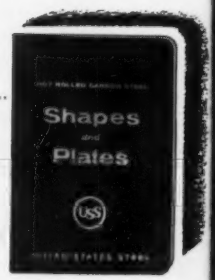

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NEWS BRIEFS . . .

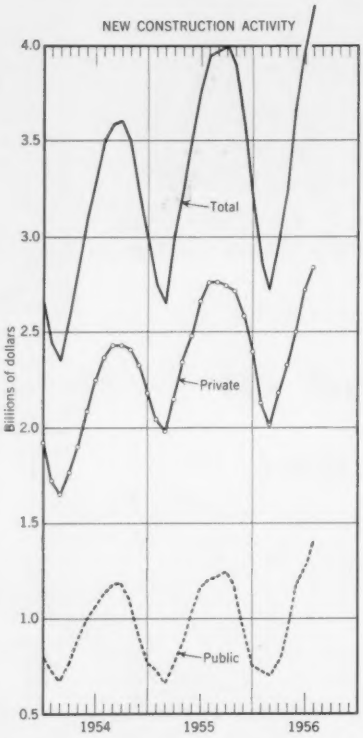
July Construction Hits New Seasonal High

New construction in July expanded seasonally to $4.2 billion, according to estimates of the U. S. Departments of Commerce and Labor. This figure surpasses the previous July high set last year, and brings the total value of construction for the first seven months of 1956 to a new record of $24.1 billion for the period.

Construction expenditures in July hit a record annual rate of $44.4 billion, when adjusted seasonally. This compares with actual outlays of $43 billion in 1955. However, the joint agencies note that the monthly estimates do not reflect the effect of shortages of steel and other materials on the volume of work put in place.

Practically all types of construction contributed to the 5 percent increase from June to July, with outlays for the following eight categories reaching all-time monthly highs: private industrial buildings, office buildings and warehouses, social and recreational buildings, public utilities, highway work, public education buildings, sewer and water facilities, and public service enterprises.

Private expenditures in the January–July 1956 period came to $17 billion, slightly above the record high for private construction outlays reached in the first seven months of 1955. Decreases in private residential building were more than offset by increases in industrial and commercial building and public utility construction. Public outlays during this period were up 5 percent over the corresponding seven months in 1955, chiefly as a result of increases in highway construction, sewer and water work, and public service enterprises.



New July construction high is set. Expenditures of $4.2 billion represent 5 percent rise over July outlays and bring annual rate to record $44.4 billion.

New York City to Have Its First Commercial Heliport

Construction of New York City's first downtown commercial heliport has been approved by the Board of Estimate, and work began on July 2. The $320,000 facility is being constructed by the Port of New York Authority on a bulkhead site at West 30th Street and the Hudson River, under the terms of a five-year lease. When the project is completed in September, New York Airways will begin regularly scheduled mail and cargo service between Manhattan and the Port Authority airports. The piles are being driven by the George W. Rogers Construction Corp., of New York City.

The heliport will include two touchdown pads, each 80 by 40 ft, projecting 40 ft out from the bulkhead. These landing pads will be made of reinforced concrete, with the portions beyond the bulkhead supported on steel H-piles. A 50- by 50-ft helicopter parking area will be provided between the touchdown pads, and a 20 by 40-ft terminal building will be constructed at the northern end of the site.

The Port Authority plans to expand the heliport into a $5,000,000 facility if its operation under the lease is successful.

Portland Cement to Open New Offices

To expand its field services to cement users, the Portland Cement Association is opening a new regional office in Los Angeles, which will supervise activities of the Los Angeles and Seattle district offices. New district offices are being opened in Baltimore, Md., Trenton, N. J., Portland, Me., and Louisville, Ky. With these new facilities, the Association will have five regional offices and 32 district offices.

Hugh Barnes, M. ASCE, has been appointed regional manager of the new Western Regional Office, which will have headquarters at 816 W. Fifth St., Los Angeles. Succeeding Mr. Barnes as district engineer in charge of the Los Angeles district office is John M. McNerney, A.M. ASCE, former field engineer in the district office. Four other field engineers have been advanced to take charge of the new district offices in the East. They are Daniel Webster, Portland; Albert L. Blackwell, Trenton; William J. Moore, Baltimore; and J. J. Farra, A.M. ASCE, Louisville.

Kaiser Company Group to Complete Australian Dam

A joint venture group of contractors under the sponsorship of Kaiser Engineers Division of Henry J. Kaiser Company has been awarded a $12 million contract for the completion of Adaminaby Dam in New South Wales, Australia. The contract with the Department of Public Works of New South Wales was signed recently by representatives of the contractors at the Australian consulate in San Francisco. The joint venture group includes the Walsh Construction Company, the Raymond Concrete Pile Company, and the Arthur A. Johnson Corporation, of New York; B. Perini & Sons, Inc., Massachusetts; the General Construction Company, Seattle; and the Bates & Rogers Construction Corporation, Chicago.

The structure, one of the highest earth and rock-fill dams in the world, is a major part of the Snowy Mountains Hydroelectric Development in southeast Australia. It will be 390 ft high, by 1,500 ft long, and will impound more than a billion gallons of water—an amount equal to eight times the volume of water in Sydney Harbor. Adaminaby Dam is scheduled for completion in 1960.

Editorial Changes on "Mechanical Engineering"

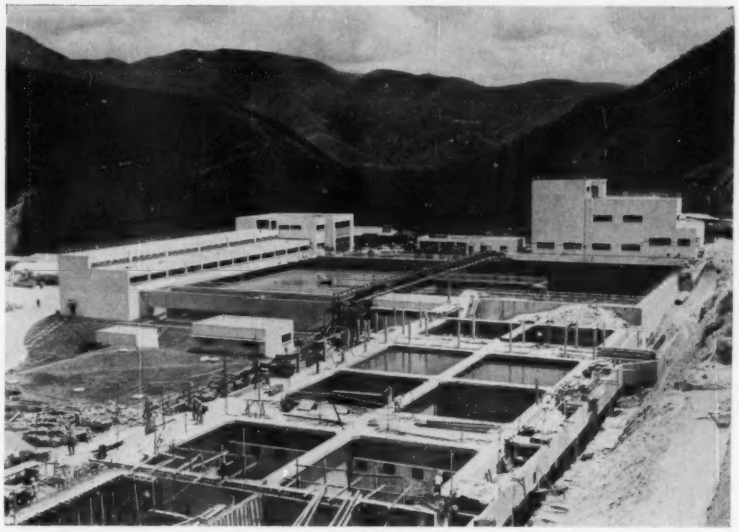
Joseph J. Jaklitsch, Jr., has been named acting editor of ASME publications. Mr. Jaklitsch, who now holds the post of associate editor, has been on the editorial staff of the society since 1945. He will succeed George A. Stetson, editor since 1930, who becomes editor emeritus. In addition to editing *Mechanical Engineering*, official publication of the ASME, Mr. Jaklitsch will also be responsible for its *Transactions* and *Journal of Applied Mechanics*.

New Group to Study Cost Engineering

Formation of a new professional organization for the growing field of cost engineering has been announced. Called the American Association of Cost Engineers, the group is the first to deal exclusively with the problems of cost engineering, which is defined as "the application of scientific principles and techniques to the problems of cost estimation, cost control, and profitability."

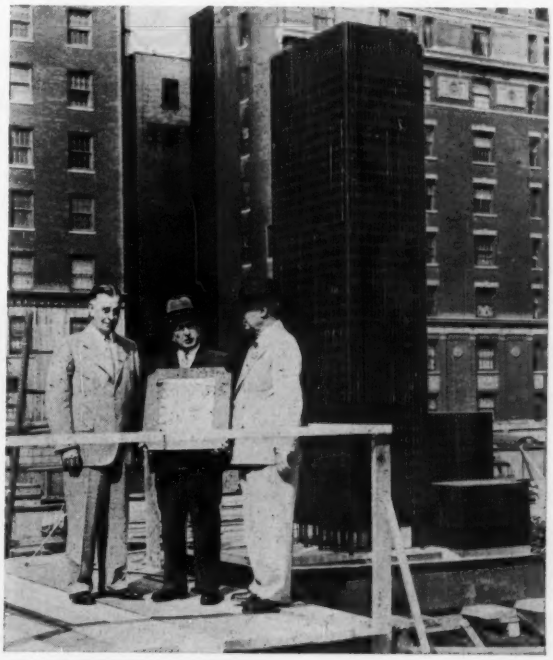
The organization meeting was held at the University of New Hampshire in June. Norman G. Bach, supervisor of engineering services for the Monsanto Chemical Company at Texas City, Tex., was elected first president.

More Water for Caracas, Booming Capital City



Fast-growing Caracas, Venezuela, is attacking its water shortage boldly. Engineering features of a project designed to supply 1.5 million people include a diversion from the Tuy River, which flows beyond the Guayabo Mountains south of the city; a 17-mile pipeline over the mountain to a terminal reservoir at Mariposa; four pumping stations in series to lift the water 3,000 ft to the summit; two tunnels (one a mile long) through rugged ridges; 128 bridges across ravines; and the treatment plant shown here. Construction of the $42 million project was begun in 1953 by a group of Swiss and German constructors, from plans prepared by the National Institute of Sanitation, of which Jesus G. Pieretti is chief engineer. President Marcos Perez Jimenez inaugurated the project on August 15. Photo courtesy of Hamilton Wright.

Bolted Building Receives "Quiet City" Award

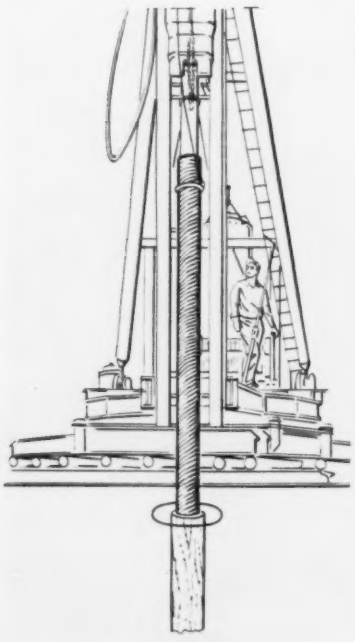


Seagram Building, now under construction by the George A. Fuller Company at 375 Park Avenue, New York, is honored with the first award made by the Committee for a Quiet City. The builders of the structure, shown here in 12-ft-high scale model, were cited for the use of new construction and other techniques that are reducing noise as much as 50 percent. Bolting the steel girders, which eliminated the noise of riveting, was one of the major innovations. The only bronze skyscraper in the world, the 38-story office building will utilize more bronze for its curtain walls than any other single project in history. The bronze wall surface will be complemented by 122,000 sq ft of glass tinted pinkish gray to blend with the bronze as it ages and weathers. The tinting will also eliminate glare, while assuring the maximum of natural daylight. A two-story replica of the building has successfully weathered hurricane tests (4 in. of rain per hour and winds up to 120 mph) to determine the watertightness and durability of window and curtain wall construction. The project will be completed late in 1957.

Walt Whitman Bridge—Another Delaware River Crossing

Last installment of floor trusses in new Walt Whitman suspension bridge over the Delaware between Philadelphia and Gloucester, N. J., is erected by Bethlehem Steel Co. The suspended roadway contains 11,733 tons of steelwork held up by two main cables, each 23 1/8 in. in dia. A project of the Delaware River Port Authority, this new $90,000,000 Delaware River crossing is 3,540 ft long. Distance between the two 370-ft-high towers is 2,000 ft. Various construction stages of the project have been described in "Civil Engineering" articles (August 1955, page 56, and February 1956, page 52). The engineers are the firms of Modjeski & Masters and Ammann & Whitney.

Cast-Steel Connector for Composite Pile Wins Award



When a wood pile is to be driven below ground-water level, and a steel or cast-in-place concrete pile is used for the upper part of the pile, a rugged connector is required to withstand hard driving. In a recent Product Development Contest of the Steel Founders' Society of America, the cast-steel connector here illustrated and shown in pile driving work, received honorable mention. Dibert, Bancroft & Ross, 3400 Tulane Ave., New Orleans, made the casting.

Seattle and Harrisburg Engineering Firms Merge

The Seattle engineering organization, Gellert, Griffin, Harrigan & Associates, has announced its affiliation with Gannett, Fleming, Corddry & Carpenter, Inc., 40-year-old engineering firm with headquarters in Harrisburg, Pa. Engineering fields covered by the unified engineering-management service include market surveys; industrial management; and design and construction of industrial plants, natural gas and electric power facilities, highways and bridges, sewer and water systems, airports and other structures.

Varied Projects on 1957 Geological Survey Program

In the 1957 fiscal year the Geological Survey will have $28,095,000 for its work in the fields of geology, topographic mapping, water resources investigations, and supervision of mineral leasing, Secretary of the Interior Fred A. Seaton announces. In addition to providing for new projects in each of the four operating divisions, the appropriation will cover additional building construction at the Survey's Pacific Coast Center at Menlo Park, Calif.

With a total of $8,513,000 appropriated for water resources investigations ($5,070,000 of it earmarked to match state funds), the largest cooperative water resources program in the history of the Survey will be in progress. The need for basic water facts for future planning, the current drought over wide areas of the West and Southwest, and the need for larger water supplies to meet expanding use in many areas, are cited as major reasons for increased state interest in the federal program. An expanded research program in the fundamental principles of water movement and occurrence is also planned. The Survey's work in recent years in training a corps of flood specialists paid off in the disastrous floods of last fall and winter. These specialists were immediately available to collect data on the flood for use in planning rehabilitation and basin development.

The Topographic Division will receive $12,873,000 for topographic surveys and mapping. The funds will be used to meet a steadily increasing demand for terrain data in the form of topographic quadrangle maps, needed for geologic and hydrologic research, for planning and construction activities, and for military and civil defense use. A measure of the increased demand for the Survey's topographic maps in the past decade is indicated by the fact that 3,000,000 copies are distributed annually in comparison with 1,000,000 copies distributed ten years ago.

Second Steel Sphere For Atomic Reactor

The Chicago Bridge and Iron Company has been awarded a contract for construction of a huge steel sphere that will house the atomic reactor being built by the General Electric Company for the Commonwealth Edison Company's Dresden nuclear power station near Chicago. The contract was awarded by the Bechtel Corporation, engineer-constructor for the plant. General Electric is prime contractor for the entire project.

The sphere, which will be 190 ft in dia, will be the second largest of its kind in the world. It will house the new G-E dual-cycle boiling water reactor and auxiliary equipment, which will power the 180,000-kw nuclear power station for the Commonwealth plant. The principal purpose of the sphere is to protect the public from any possible radioactive products released in the remote chance of failure of all other safety devices.

Ground for the project will be broken early next spring. The sphere will be completed by early 1958, and the entire plant will be in operation by 1960.

Cement Plant to Be Built in Everglades

Plans are under way for construction of a $20,000,000 cement plant in the Everglades area of Florida, about seven miles west of the Miami International Airport. The plant will have an annual capacity of 2,000,000 barrels of portland cement, which will help relieve the critical shortage that has existed in Florida since the war.

The Lehigh Portland Cement Co., the builder, already operates a plant at Bunnell, Fla., using native coquina shell as the principal raw material. The proposed new plant will reclaim rock from under the sawgrass and muck of the Everglades for use in the manufacturing process.

Federal Sanitary Engineers Elect New Officers

The Conference of Federal Sanitary Engineers has elected the following officers for the year beginning June 1: Gordon McCallum, sanitary engineer director of the U.S. Public Health Service, president and chairman of the board; Mark D. Hollis, assistant surgeon general, USPHS, president-elect; and Alvin F. Meyer, Jr., lieutenant colonel, USAF, secretary-treasurer. All are members of ASCE. This is the conference's first full slate of regular officers since its formation about a year and a half ago.

Formed for the general purpose of bringing together government engineers engaged in the sanitary engineering profession (including industrial hygiene), the conference has the specific aim of supporting the recently formed Intersociety Board for Certification of Sanitary Engineers. It is cooperating with existing technical and professional societies in the various functional areas of sanitary engineering designed for the promotion of public health. Information may be obtained from Colonel Meyer, 1502 South 94th Street, Omaha 6, Nebr.

Driving of Piles for Huge Camden Dock Completed

Floating pile drivers have finished hammering 8,400 steel sheet piles, ranging in length from 72 to 100 ft, into the bed of the Delaware River at Camden, N. J., in constructing the country's largest privately owned graving dock. The dock is being built on a four-acre site by the New York Shipbuilding Corporation, which will use it in construction of the "Kitty Hawk," the Navy's newest super aircraft carrier. The 60,000-ton carrier will be almost one-fifth of a mile long and 25 stories high, too large for erection on any shipway.

The New York Shipbuilding Corporation, which operates as the Shipbuilding Department of Merritt-Chapman & Scott, is building the carrier under a $120,000,000 low-bid contract. The Construction Department of Merritt-Chapman & Scott is participating in construction of the giant graving dock, which will be 1,000 ft long, 150 ft wide, and 49½ ft deep.

The most exacting phase of the work to date has been the precision driving of the heavy steel piles for the horseshoe-shaped cell wall and the nine circular cofferdam walls that seal the river end of the dock during construction. After excavation of some 730,000 cu yd of earth, the derricks were floated into position, side by side, at the inboard end of the graving dock area. Working their way back toward the river, they hammered out 66 elliptically shaped, 54-ft-wide, 36-ft-long, interlocking cells.

Construction of the drydock's 22-ft-thick floor of solid concrete will be done in the wet by the Prepakt method. The dock area will be pumped out after the underwater slab has cured, permitting completion of the remainder of the work in the dry. Work in the dry will include the construction of heavy portals of reinforced concrete tying into the outboard cell on each side of the dock, and placement of a 8-ft-thick concrete sill between the portals. The caisson-type steel gate will be assembled in place atop the sill. When the gate is flooded to bring it into position as a watertight seal, its top will be 6½ ft above mean high water.

Each portal of the graving dock will house a 60,000-gpm pump for dewatering operations. Flumes, through which the graving dock will be filled and dewatered, also are located in the portals. Two new 100-ton gantry cranes will be assembled to service the dock, and four others can be brought in by transfer tracks from the company's adjoining ways and piers for use as required.

It is expected that the keel of the carrier will be laid in the fall of 1956, and the carrier itself finished and ready for delivery to the Navy in 1959.

Pile drivers on floating derricks finish driving 8,400 heavy steel sheet piles, from 72 to 100 ft long, in construction of 66 cells forming dock wall.

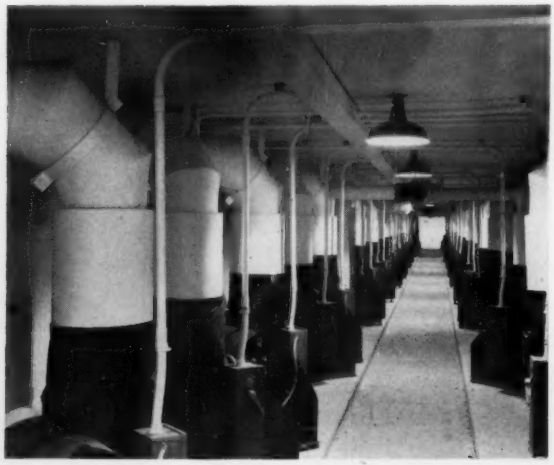
Laboratory building of fireproof construction has reinforced concrete frame and walls of brick, stone, and glass. Setting in park-like estate of late Otto Kahn in Morristown, N. J., provides detachment from production-line problems believed helpful to scientists engaged in pure research.

Industrial Laboratory with a Future

Among the problems to be solved in the design of industrial laboratories are the provision of ready access to utility and product lines, safety, low maintenance, and the location of laboratory areas as close as possible to the administrative offices. These needs are well met in the new research center for the General Chemical Division of the Allied Chemical and Dye Corporation in Morristown, N. J. In addition to well-planned functional facilities for chemical research, this center offers a setting conducive to creative work—the park-like estate of the late Otto Kahn.

To avoid problems of prestige, all laboratory rooms are identical in size, layout, and facilities, being built on a module of 22 by 24 ft. There is a condenser rack in the middle of the room, a desk, and working shelves against the walls.

(*Continued on page 102*)

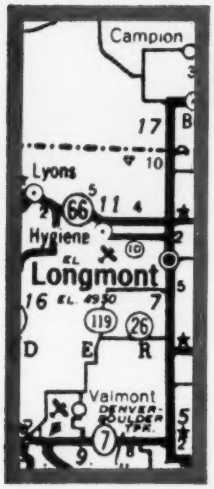


Rooms are arranged on each side of corridor (left-hand view). Note acoustical ceiling treatment, walls of glazed tile, flush wood doors, and asphalt tile floors which facilitate maintenance. Closet doors, between laboratory doors, permit separate control of facilities for each laboratory from corridor. Gallery under roof (view at right) provides control and access to exhaust fans for every laboratory. Each lab area has four exhaust hoods for toxic gases, two high and two low, each operated independently.

STANDARD MC-3 Cut Back Asphalt is applied to Boulder County Highway 10. Standard Asphalt engineer Oscar Jones (left) and Highway Superintendent Douglas N. Stewart check application.

Ordering STANDARD Asphalt

makes job easier for Boulder County Highway Department



As the link between Longmont and State Highway 66, Boulder County Highway 10 gets plenty of traffic. To take this traffic, road is surfaced with STANDARD Asphalt.

Boulder County Highway 10 in Colorado links the city of Longmont with State Highway 66 three and a half miles to the west. It is a popular highway for travel to Rocky Mountain National Park and for farm-to-city traffic. Maintenance of this highway in first class, all-weather condition is made easy by the use of STANDARD Asphalt. The Boulder County highway department gets these benefits from ordering asphalt requirements from Standard: (1) top quality product and (2) an assured source of supply.

And there are still more advantages to ordering asphalt from Standard Oil. Standard's experienced asphalt salesmen know the needs of road builders and are qualified to work with them in planning requirements. Standard Oil has long experience as an asphalt supplier, knows what it means to protect customers on supplies and deliveries.

You can get these advantages when you buy asphalt from Standard. Find out. Call your nearby Standard Oil Office in any of the 15 Midwest and Rocky Mountain states, or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD **STANDARD OIL COMPANY (Indiana)**

Highway 10 running west of Longmont, Colorado to State Highway 66 is 24 foot wide, asphalt surface, all weather highway. Standard Oil's Oscar Jones and Highway Superintendent Douglas N. Stewart inspect road recently resurfaced.

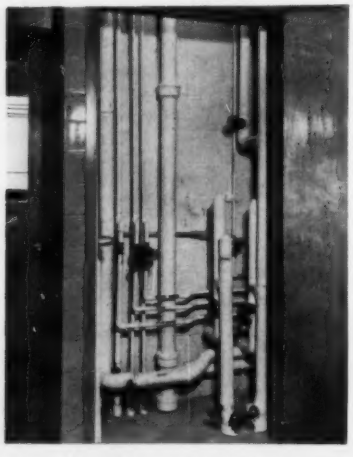
In case of an explosion or other emergency, any laboratory can be completely closed off. Basic services—such as gas, steam, water, vacuum, electricity—are distributed to each room by vertical risers from the main ducts running just above the basement ceiling. Controls for the risers serving each laboratory are in a closet opening on the corridor, so that it is not necessary to enter the room to turn services on or off. Easy access to the ducts is provided through the basement ceiling, which is composed of removable asbestos-cellotex sandwich panels $1^{3}/_{4}$ in. thick. Each panel is held in place by studs shot into the angle irons which support the hung ceiling.

Each room has four exhaust hoods for toxic gases, two high and two low, each completely independent. The exhaust gallery at the top of the laboratory wing provides access to blowers. A separate fan serves each exhaust. The air intake for the exhaust system is at grade since most gases rise, but an asbestos baffle at the roof level is so arranged that heavier-than-air gases will rise sufficiently to be diffused before falling to the ground.

Toxic chemicals used in the experiments led owner and architect to choose aluminum for exposed metal parts such as window frames, lintels, air intakes, exhaust louvers, and exterior doors. Another reason for this choice was ease of maintenance since these aluminum elements will not require painting. Also for easy maintenance, interiors in working areas are of glazed tile.

The main laboratory wing is designed so that both the first floor and the basement are accessible to trucks for delivery of supplies, without using elevators. The new wing which it is planned to add at the rear will be designed on the same principle.

The building was constructed by the George A. Fuller Co., and Fellheimer & Wagner, New York, were architects and engineers.



Door of closet (shown at far left) is opened in the view above to show controls for steam, gas, vacuum, etc., which can easily be shut off from corridor in case of emergency.

New Civil Engineering Projects in Colonial Countries

S. B. HAMILTON

Past-President, British Institution of Structural Engineers

Current civil engineering projects include this new teaching hospital under construction at Ibadan. Unit will be Nigeria's first teaching hospital and will provide beds for 500 in-patients, operating theaters, and pathological, X-ray, and other facilities.

A wide and impressive range of construction projects is currently being carried out by Great Britain in her non-self-governing territories.

Important harbor works are already completed or in progress in West Africa. These works include a recently completed wharf at Bathurst, in Gambia, and deep-water ports at Freetown, in Sierra Leone. Along the Gold Coast the harbor of Takoradi, which previously had berths for three ocean-going liners, has been enlarged to accommodate six. The new modern port of Tema, near Accra, will eventually have berths for 20 large ships and will be the largest entirely artificial harbor in Africa.

In Nigeria, the berthing facilities at Apapa, the port of Lagos, have been greatly extended, with the construction of warehouses, marshalling yards, and staff quarters, much of it on land reclaimed from the sea. In East Africa, port facilities have been expanded and new berths constructed at Mombasa, Dar-es-Salaam, and Tanga. A new port has also been constructed at Mtwara.

In many cases the full value of the new facilities depends on transportation facilities between the ports and their hinterland. In the Gold Coast, a network of roads and railways is being built for the purpose. There are also some remarkable bridges, including an impressive steel-arch structure to carry the road to Togoland across the Volta River. A new road crossing hills and valleys like a switchback links Nigeria with the Cameroons by a 350-ft suspension bridge over the Cross River. In the Federation of Malaya a double-deck bridge more than 600 ft long is to be built over the River Klang, and general improvement of bridges and road surfaces is planned.

Although the tonnage carried by Rhodesian Railways increased by 50 percent between 1950 and 1955, still further provision for transport is necessary. Newly constructed lines include a 200-mile-long connection to link the Southern Rhodesia rail system with that of Mozambique—to relieve the congested route between Salisbury and Beira—and one 90 miles long extending northwards from Sinoia to serve the site of the Kariba Dam on the Upper Zambesi.

In nearly all the dependencies, new industries have been developed, and the demand for power is insistent and growing. In many parts of Africa this demand is being met by harnessing the great swift rivers that flow from the central uplands. Kariba Dam, the first stage of which is planned to provide 500,000 kw of power at a cost of about $224,000,000, will impound a lake 150 miles long, the largest man-made stretch of water in the world. The complete project, which will provide 1,200,000 kw of power, is estimated to cost $316,400,000. Owen Falls Dam in Uganda, which draws on the Nile as it leaves vast Lake Victoria, will be less

(*Continued on page 104*)

Unique Horton Water Tower at Gerber's

It would be hard to measure the publicity value of the special Horton® water tower shown above, built for Gerber Products Inc. at Rochester, New York. A replica of the nationally known Gerber Baby Foods jar, it towers above the surrounding area.

A more tangible benefit of this unique water tower is the adequate water supply it provides for fire protection. No matter the hour, water will flow from the tank under dependable gravity pressure the moment a sprinkler head opens.

It has been estimated that the Gerber Baby Food water tower and the complete sprinkler system installed in the plant will pay for themselves in approximately five years through reduced insurance premiums...a wise investment for any company.

Write our nearest office for further information on Horton elevated tanks of standard or unique design.

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(*Continued from page 102*)

costly, and have a slightly greater power output.

Another great project is in prospect for the Shire River in Nyasaland. Nigeria's latest addition to its power resources is the large modern generating station known as Ijora B, which had to be built to float, virtually, on a vast concrete raft. In the Gold Coast, a plan to harness the Volta River to produce up to 564,000 kw is in the preliminary stages.

The new oil refinery opened at Aden in 1954, is one of the largest oil-bunkering ports in the world. This refinery, capable of handling 5,000,000 tons of oil a year, was constructed for the British Petroleum Company Ltd. In addition to the refinery itself, the project included building a complete new port and town six miles to the west of the old port of Aden.

Projects involving drainage, irrigation, or a combination of both, are under way in many dependencies, to utilize potentially fertile waste land in coastal plains or the flood plains of the larger rivers. An example in the Federation of Malaya is Perak, where 180,000 acres of swampy jungle are to be turned into rice-growing land. Irrigation is also the most important engineering work under way in British Guiana. A project at Boerasirie will shortly provide 130,000 acres of cultivable land along the coast between the Essequibo and Demerara rivers.

Airport facilities—vitally needed for both large and heavy long-distance aircraft and the smaller planes in increasing local use—are rapidly being expanded in many territories.

Consulting Engineers Form National Organization

Formation of an organization of consulting engineers on a nationwide scale took place at a two-day meeting held at Tulsa, Okla., early in July. Called the Consulting Engineers Council, the new organization will act as a central agency for the exchange of ideas and the correlation of services between various independent associations of consultants. Its objective will be "to protect the public, promote harmony, cooperation, and mutual understanding among independent consulting engineers engaged in private practice."

Officers of the new organization are John K. M. Pryke, New York City, president; Charles C. Pate, Tulsa, first vice-president; Bernard Dornblatt, M. ASCE, New Orleans, second vice-president; Edward J. Wolff, Chicago, secretary; and W. C. E. Becker, M. ASCE, St. Louis, treasurer.

Pending selection of an executive secretarial staff and establishment of permanent headquarters, the Council will operate through the office of the New York Association of Consulting Engineers, 220 East 42nd St., New York 17, N. Y.

N. G. Neare's N. COLUMN

R. ROBINSON ROWE, M. ASCE

The September meeting of the Engineers Club erupted when the House Committee recommended buying a narrow lot behind the clubhouse to build an 18-story annex for a new entrance facing the park. The west-siders called it a slum location, pointing to the shift of the population to the west, with the best people and nicest homes the other side of the river.

"Put it down by the river handy for everybody," suggested Cal Klater.

"It's always been on Ragpicker's Lane," argued Joe Kerr, "and that's good enuf for me."

"Let's build where we can be as proud as we are of our Seven Engineering Wonders," pleaded Professor Neare.

"It has to be handy for the janitor and he lives on the east side," thundered the House Committee, and it won on a show of hands.

"Well, if we must be ridiculous," conceded the Professor, "let's add a symbolic decor of letters and digits to one side of your windowless setback annex (Fig. 1). Each of the 10 different letters corresponds to one of the digits. Decoding the letters expresses symbolically that ASCE + AIEE + ASME + AIME + AIChE = Center; decoding the digits emblazons from top to bottom of the elevator tower the common characteristic of all engineers. Can you decipher the code?"

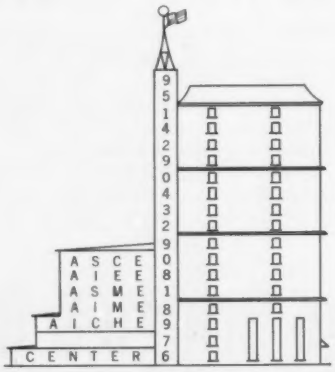


Fig. 1. Symbolic decor of Park Avenue Annex to Esseyeville's old Engineers' Club on Ragpicker Lane.

"Right now?" asked Joe Kerr.

"No, you'll need a little time. Let's hear what you did with the half-and-half problem."

"Did it with models," grinned Joe. "I punched holes in two coffee cans and rigged one above the other on shelves over the kitchen sink. Being out of cream, I filled the upper can with Old Gull, the lower one with soda, and let them go with Fay holding a watch and me holding a sampler under the lower can. In 15 min it began to taste groggy, was still weak at 20, and just my style at 27. The next morning . . . ."

"The next morning," echoed Cal, "he looked like an old gull, and frankly, so did I after my scientific but less exhilarating solution. Using tanks of unit height and section and running time backwards, depth of cream in the upper tank is $\dot{y} = t^2$ and the discharge into the lower tank is $\dot{y} = 2t$. Then if z is the depth of the mixture and p the proportion of milk in it, we have:

$$2\sqrt{z} = \dot{y} + \dot{z} = 2t + \dot{z}. \quad . \quad . \quad (1)$$

$$z\dot{p} = p\dot{y} = 2pt \quad . \quad . \quad . \quad . \quad (2)$$

"The problem is to eliminate z from these two differential equations and find t when $p = 1/2$. Defining the parameter u by $\sqrt{z} = t(1 + u)/(1 - u)$,

$$\frac{dt}{t} = \frac{-2(1 + u)du}{(1 - u)(1 + 3u^2)} \quad . \quad . \quad . \quad (3)$$

$$\sqrt{3} \log \frac{t^2(1 - u)^2}{1 + 3u^2} = 2 \tan^{-1} u\sqrt{3} \quad . \quad (4)$$

$$\frac{dp}{p} = \frac{2tdt}{z} = \frac{-4(1 - u)du}{(1 + u)(1 + 3u^2)} \quad . \quad (5)$$

$$\sqrt{3} \log \frac{(1 + 3u^2)}{p(1 + u)^2} = 2 \tan^{-1} u\sqrt{3}. \quad . \quad (6)$$

"When $p = 1/2$, (6) can be solved by interpolation of trials to find $u = .2248016$, and (4) and (6) can be combined to find the answer

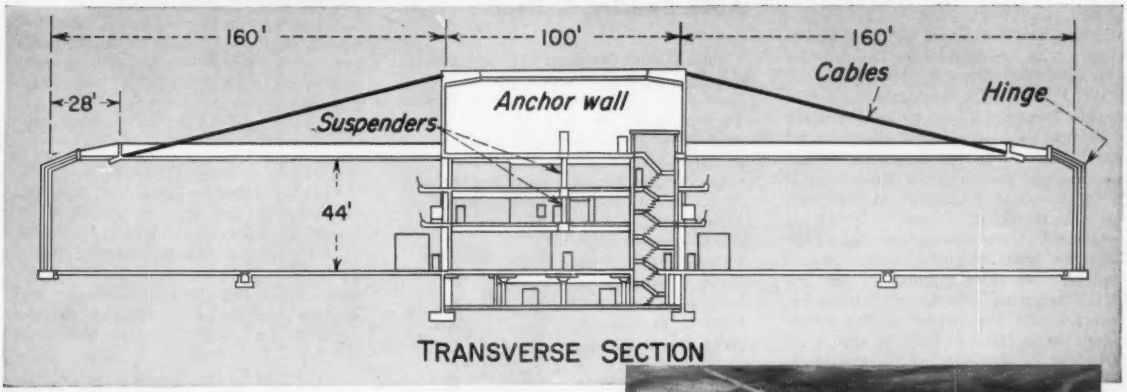
$$1 - t = 1 - \frac{1 - u^2}{(1 + 3u^2)\sqrt{2}} = .4170125 \text{ hr.}"$$

"Or about 25 min," concluded the Professor, "so Joe's taste for hiballs is fairly accurate. He just forgot to allow for the shrinkage of the supersaturated soda."

[*Several Joe Kerrs modeled or graphed answers ranging from 7 to 48 min; soberer Cal Klaters were Ed C. Holt, Jr., and Rudolph W. Meyer.*]

A NEW FIELD OF APPLICATION FOR HIGH STRENGTH CABLES...

SUSPENDED ROOFS



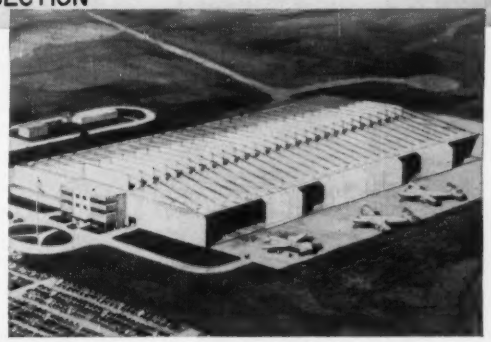
TRANSVERSE SECTION

FOR A HUGE HANGAR at the new Kansas City, Mo. airport, column-free space is being obtained by cable suspension of the thin-shell concrete roofs on each side of a central structure. The supporting cables – supplied by Roebling – will be anchored in 30-ft.-deep concrete walls which span between the building columns at 30-ft. intervals, and received at point of suspension on the roofs by steel sleeves buried in the concrete.

This new application is another major step in the recognition of the economy of axially stressed members in general, and high strength wire tension members in particular. The designers are to be congratulated for pioneering the ideal answer for hangars, bus and truck terminals, gymnasiums, sports arenas, armories and other structures in which a large expanse of unobstructed space is essential.

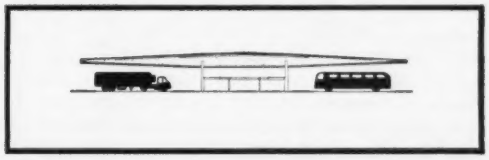
The Roebling Bridge Department's Specialized Technical Service is always available for consultation, advice and creative design work on new applications of wire members to physical structures. In addition, our Bridge Department products . . . bridge wire, bridge strands, bridge rope and fittings, castings, prefabricated members, etc.–are recognized as the standard the world over.

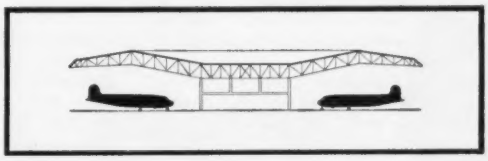
We should be glad to hear about any structural project, planned or in progress, in which we might be of assistance. Write Bridge Department, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.



TOP: Sectional drawing of hangar showing cables that support the two corrugated concrete roofs, each 818 x 150 ft., plus a 10-ft. door overhang. Four 2½" strands, each with a tensile strength of 752 kips, extend from the ends of 28 "anchor walls." Each wall is prestressed by two 2¼" post-tensioned strands. INSET: General view of TWA hangar at the new Kansas City Mid-Continental International Airport. Engineers and Architects, Burns & McDonnell, Kansas City; Consulting Engineers, Ammann & Whitney, New York City; Contractors, MacDonald-Creighton, St. Louis and Nashville.

BELOW: Two other interesting designs: (1) A prestressed concrete structure. (2) The "gull wing" type, employing a combined truss and cable system.





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DECEASED

Frederick N. Cronholm (M. '19), age 72, consulting engineer and expert on flood control, died at his home in North Palm Springs, Calif., on June 7. Mr. Cronholm was liaison engineer for the Corps of Engineers at Los Angeles for twelve years prior to his retirement to private practice in 1950. In 1947 he was granted leave of absence from the Corps to head a party of experts on land use and development sent by Morrison-Knudsen, Inc., to aid the Iranian government. Before going to the Corps of Engineers, he was with the Metropolitan Water District of Southern California on construction of the Colorado River Aqueduct, and general manager and chief engineer of the Imperial Irrigation District with offices in Calexico. At the outset of Mr. Cronholm's career (1908 to 1918) he was superintendent of construction for the U. S. Bureau of Reclamation.

Charles Derleth, Jr. (M. '08), age 81, professor emeritus of civil engineering at the University of California, died in Berkeley on June 13. Educated at City College of New York and Columbia University, Professor Derleth first taught at the University of Colorado. In 1903 he joined the faculty of the University of California as assistant professor of structural engineering. At the time of his retirement, 41 years later, he was chairman of the civil engineering department. An important figure in development of the bridge system of the Bay area, he was chief engineer on the present Carquinez Strait Bridge which connects the Bay area directly with the Sacramento Valley, and served on the board of engineers for the Golden Gate Bridge and as consultant on the Bay Bridge and the Richmond-San Rafael Bridge now under construction. As a young man he was assistant engineer on both the City Island Bridge in New York City and the Memorial Bridge over the Potomac at Washington, D. C.

Hardy S. Ferguson (M. '01), age 87, retired consulting engineer of Cape Elizabeth, Me., died at his home there on July 6. Mr. Ferguson maintained offices in New York City from 1911 until his retirement in 1950. For many years he was also connected with the Great Northern Paper Co. He was known as designer of Ripogenus Dam in Maine, once one of the largest artificial storage basins in the world, and was a consultant to the International St. John River Commission.

Victor L. Fixen (M. '20), age 70, retired mining engineer and lawyer of Minnetonka, Minn., died there recently. A 1911 graduate of the University of Minnesota as a mining engineer, Mr. Fixen received his law degree there in 1918. He practiced in Minnesota and Illinois and was a member of Hennepin County bar association. He had been a lecturer at the University of Minnesota, Institute of Technology since 1929.

John H. Gardiner, former ASCE Director, Is Dead

John Haines Gardiner (M. '36), age 61, district engineer of the U. S. Geological Survey, Water Resources Branch, died in Tucson, Ariz., on July 27. He was a graduate of the University of Arizona with a degree in electrical engineering, class of 1918. Mr. Gardiner joined the U. S. Geological survey in 1920, transferring from the water investigation division in Arizona in 1929 to Fort Smith, Ark., where he was district engineer in charge of water resources. Since 1938 he has been in Tucson as district engineer.

J. H. Gardiner

Mr. Gardiner served as ASCE Director from 1945 to 1947. He also was secretary, vice-president, and president of the Mid-South Section; president of the Arizona Section; and Contact Member for the University of Arizona Student Chapter.

Frederick T. Hepburn (M. '06), age 83, retired public utilities executive and former mayor of Lattingtown, N. Y., died at his home there on June 16. Mr. Hepburn resigned last year after serving as mayor and trustee of the village of Lattingtown for twelve years. A civil engineering graduate of Renssalaer Polytechnical Institute, class of 1893, he later became a life trustee of the institute. He began his career with the Pennsylvania Railroad, and later was general manager of the Ohio Electric Railway. From 1911 to 1927 he was president of the former H. D. Walbridge & Co., New York utilities firm. During this period, he was also president of the Penn Public Service Co., with offices in New York, and a partner in Frederick T. Hepburn Co., investment securities. Until recently Mr. Hepburn was a director of the Electric Bond and Share Co. in New York City.

George Philip Heneghan (M. '52), age 57, an associate of James A. McCarthy and Associates, consulting engineers of South Bend, Ind., died on July 26. From 1941 to 1954 Mr. Heneghan was with the Chicago office of the Roberts and Schaefer Co. as supervising engineer on design and construction of thin shell-type concrete structures, hangars, etc. Earlier he had been assistant general manager of the Dean Steel Corp. in Chicago; project engineer for the Indiana State Highway Commission; and assistant superintendent of the South Bend water works. He was a graduate of the University of Notre Dame, class of 1922.

William Albert Heindle (M. '12), age 87, retired public utility engineer of Wilmington, Del., died there on June 18. Mr. Heindle was superintendent of street railways in Wilmington for the old Wilmington and Philadelphia Traction Company from 1910 to 1920. From then until his retirement in 1933 he was president of Heindle, Samworth Contracting Construction Company. In 1929, he was appointed to the Wilmington Board of Public Utility Commissioners and served for 20 years. Mr. Heindle was a graduate of Lehigh University, class of 1887.

Carl R. Hinshaw (M. '48), age 62, civil engineer and member of the U. S. House of Representatives from California died on August 5th at Bethesda Naval Hospital in Washington, D. C. He was a member of the House Interstate and Foreign Commerce Committee and the Joint Congressional Committee on Atomic Energy. A graduate of Princeton University, he received a civil engineering degree in 1916, and did post graduate work at the University of Michigan in business administration. Mr. Hinshaw served during World War I as a captain in the Army Corps of Engineers. A specialist in transportation problems, Mr. Hinshaw was instrumental in helping Pasadena obtain the Arroyo Parkway. In 1929 he went to Pasadena and began a real estate and insurance business. He was elected to the Seventy-sixth Congress in 1938 and returned to each succeeding Congress.

Carl R. Hinshaw

Alfred Martin Kaehrle (A.M. '49), age 47, former assistant director of the Bureau of Traffic Planning and Design of the Connecticut State Highway Department, Hartford, Conn., died there July 4. A 1930 civil engineering graduate of the Sheffield Scientific School of Yale University, he was first employed by the Port of New York Authority on the construction of the George Washington Bridge. He then opened offices in Hartford as a traffic engineering consultant, specializing in highway planning, traffic and parking studies, layout, and design reports. Last June he joined with two associates to form the firm of Alfred Kaehrle and Associates, consulting engineers.

Ford Kurtz (M. '19), age 71, president and director of the J. G. White Engineering Corp., New York City, died in Newberry, S. C., on August 9. A specialist in hydraulic engineering, Mr. Kurtz was consulting engineer on the Svirstroi Dam

(*Continued on page 108*)

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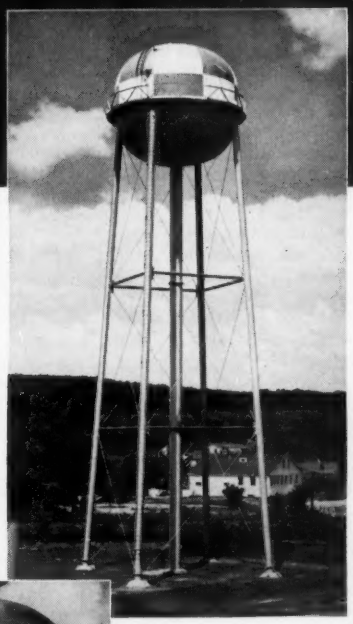

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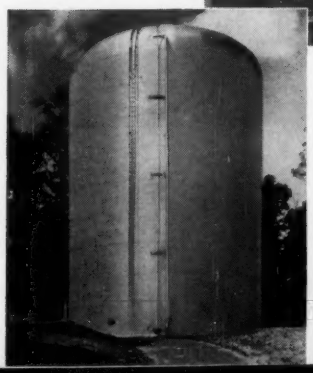

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DALLAS (1)...1275 Praetorian Bldg.
SEATTLE.....578 Lane Street
SANTA CLARA, CAL., 677 Alviso Road
MADRID, SPAIN....Diego DeLeon, 60

Deceased

(*Continued from page 106*)

in the Soviet Union, Fort Peck Dam in Montana, and other important projects in this country and abroad. He began his long association with the J. G. White Corporation in 1910 as assistant engineer, becoming successively chief hydraulic engineer in 1928 and president in 1953. Early in his career, Mr. Kurtz was resident engineer on the construction of the hydroelectric plant at Parr Shoal, S. C., and the steam power plant at Muscle Shoals, Ala. Later he designed many hydroelectric developments, including the Oak Grove plant in Oregon and the Saluda plant in South Carolina. Mr. Kurtz received a civil engineering degree from Cornell University in 1907. He was a member of the U. S. Committee on Large Dams of the World Power Conference, and served ASCE as secretary of the Power Division.

Ford Kurtz

John W. Mangan (M. '37), age 59, district engineer in the State of Pennsylvania for the U. S. Geological Survey, Water Resources Division, Surface Water Branch, and chief of the Division of Hydrography, Pennsylvania Department of Forests and Waters, died recently in Harrisburg, Pa. Mr. Mangan was a civil engineering graduate of the University of Michigan and a veteran of World War I. He was with the Interstate Commerce Commission for a brief period before joining the U. S. Geological Survey in 1923. He became district engineer in Pennsylvania in 1931.

Kirpal Singh (M. '19), age 73, principal, Shri Vishvakarma Polytechnic Institute, Phagwara, East Punjab, India, died at his home there recently. A civil engineering graduate of the City and Guilds Institute, London, England, class of 1915, he did postgraduate work there and at the Imperial College of Science and Technology in London. He was senior engineer in charge of the construction of the dam for the hydroelectric supply in Anohra Valley at Bombay, India and had also been associated with the Public Works Department of Punjab for over ten years working on the Jata Hydro-Electric works and many other important irrigation works. A prominent professor of mechanical engineering, he taught at the College of Engineering at Poona; Victoria Diamond Jubilee Hindu Technical Institute, Lahore, India; Maclagan Engineering College, Lahore, India; and for the past several years was principal at Shri Vishvakarma Polytechnic Institute.

Howard W. Smith (M. '35), age 73, retired civil engineer of Kansas City, Mo., died at his home there recently. Mr. Smith began his career as a resident engineer with the Chicago Milwaukee & St. Paul Railroad in Western Dakota, leaving after several years to join the Laclede, Dallas & Western Railroad as chief engineer in charge of location and construction. From 1911 until his retirement in 1943, he was with the Kansas City Public Service—after 1926 as engineer of way and structures in charge of maintenance of track, paving, bridges and buildings. Mr. Smith was a veteran of World War I having served as a lieutenant in the Corps of Engineers.

Eugene Henry Uhler (A.M. '27), age 71, structural engineer and retired professor of civil engineering at Lehigh University, Bethlehem, Pa., died at his home in Newton Square, Pa. recently. A graduate of Lafayette College with a civil engineering degree in 1908, Prof. Uhler began his career as an instructor in mathematics and surveying at St. John's School, Manlius, N. Y., for a year, and as assistant professor of civil engineering at Heffley Institute in Brooklyn, N. Y., for two more years. From 1913 to 1918 he was associated with the Bridge & Building Department of the Pennsylvania Railroad in the design of subway and elevated structures. During six years of this time he was also assistant professor of civil engineering at Lafayette College. In 1919 he joined the faculty of Lehigh University as assistant professor of civil engineering, retiring as professor in 1948.

George Steffen Wall (M. '44), age 51, consulting engineer of Cleveland, Ohio, died at his home there recently. He was a civil engineer for the City of Euclid, Ohio, for 11 years and engineer for Cuyahoga County, Ohio, for five years. During this time he maintained a private practice and designed plans for the Brook TNT Plant near Sandusky, Ohio. Mr. Wall was associated with the U. S. Government during World War II as assistant to the area engineer on construction of large bomber plants including the one at Cleveland Airport, and later served in the Corps of Engineers as a first lieutenant. Since the war he has been in private practice under the firm name of George S. Wall & Associates.

Edward Ashton Ward (M. '23), age 69, retired president of the William H. Lutton Company of Jersey City, N. J., died at his home in Green Village, N. J. recently. A graduate of Stevens Institute of Technology, class of 1908, Mr. Ward was an instructor in structural engineering and surveying there for two years. In 1910 he joined the New York Central & Hudson River Railroad as a designer, leaving in 1914 to become engineer in charge of construction and treasurer of the William H. Lutton Co., designers, manufacturers, and constructors of greenhouses. He became president and general manager in 1921 and after 30 years of service retired in 1944 as president. For the past several years he has been associated with the Obscurator Company of Green Village, N. J.

Positions Announced

Army Corps of Engineers. The Engineer Center and Fort Belvoir at Fort Belvoir, Va., have openings for Civil Engineers GS-5-7-9-11 (salaries from $4,480 to $7,035) per annum, and Structural Engineers GS-9 (salary $6,115) per annum. A Standard Form 57 obtainable from any Civil Service or Department of the Army Civilian Personnel Office, should be filled out and brought or mailed to: Civilian Personnel Office, Employment Division, Room 200A, Building 211, The Engineer Center and Fort Belvoir, Fort Belvoir, Va.

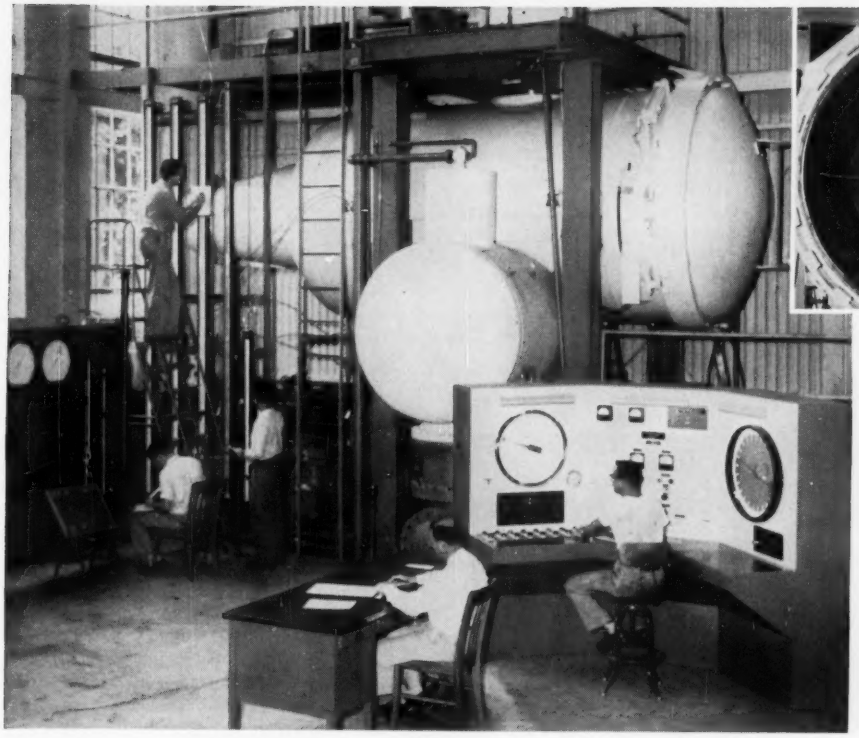
City of Phoenix. The City of Phoenix, Ariz., has an opening for a Utilities Engineer, who will assist the Superintendent of Water and Sewers in the administration of the water and sewage systems. Salary range from $575 to $700 per month. Considerable experience in a progressively responsible technical and administrative capacity, including engineering and operations experience in a water utility or sewage system, is required, plus graduation from a four-year university with specialization in civil, mechanical, or sanitary engineering. Applicant must be between 25 and 55, and eligible for registration in the State of Arizona. Apply to Leroy J. Brenneman, Personnel Director, City Hall, Phoenix, Ariz.

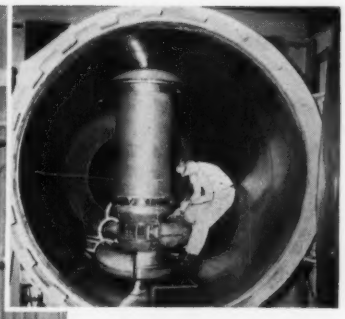
City of Riverside. The City of Riverside, Calif., has vacancies for 3 qualified engineers as Associate Engineers in public works. Salaries range from $478 to $598 per month. Applicants must be college graduates with engineering degrees and two years of responsible experience in civil or mechanical engineering, or an equivalent combination of training and experience. There is also an opening for a Traffic Engineer (same salary) with a degree in civil engineering, including courses in traffic engineering and with two years traffic engineering experience. Applicants who best meet qualifications will be interviewed to determine their training, experience, and personal fitness for the position. Personnel Department, City Hall, Riverside, Calif.

U. S. Department of Agriculture. The Engineering Division of the U. S. Soil Conservation Service has openings in the fields of Structural Design, Hydrology, Hydraulics, and Construction. Vacancies exist in GS-5-7-9 and 11 grades with starting salaries ranging from $4,345 to $7,035, depending on the background of education and experience. They are located throughout the United States and in Washington, D. C. These jobs offer excellent opportunities for intensive specialized training in a Career Service Agency. Further information is available from Director of the Personnel Management Division, Soil Conservation Service, Washington 25, D. C.

United States Department of Agriculture. The Soil Conservation Service has an opening for an Agricultural Engineer (Conservation) who will be under the general supervision of the Area Conservationist, with considerable latitude for independent action and decision. Location is Wausau, Wis., and salary $6,115 per annum. Applicants must meet requirements of Grade GS-7 engineers. Further information from Charles H. Buell, State Administrative Officer, U. S. Department of Agriculture, Soil Conservation Service, 3010 E. Washington Avenue, Madison 4, Wis.

U. S. Navy. Overseas career opportunities for graduate engineers with the Navy in the Pacific Ocean area in the Marianas Islands, the Philippines, Japan and other locations. Most vacancies will be on the Island of Guam and Sangely Point and Subic Bay on the Island of Luzon in the Philippines. Engineers GS-5 (salary $4,480) per annum, GS-7 (salary $5,335); GS-9 (salary $6,115); GS-11 (salary $7,035), and GS-12 (salary $7,570) per annum. Transportation provided for family when authorized. Standard Form and a card Form 5001 ABC, obtainable from post offices, or State Employment Service, should be filled out and sent to Navy Overseas Employment Office (Pacific), 45 Hyde Street, San Francisco, Calif.





A complete model turbine wheel case assembly, built to extreme accuracy, is shown being mounted in the testing chamber.

New high head test stand in the SMS Hydraulic Laboratory, including control panel and gages.

High Head Turbine Test Stand At SMS Laboratory DUPLICATES FIELD CONDITIONS

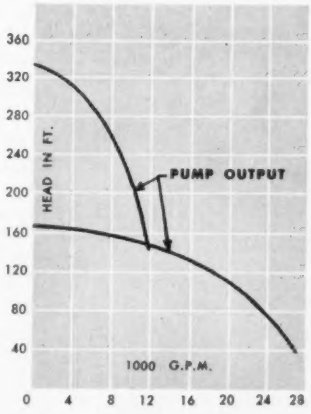
With the addition of its new high head test stand, the SMS Hydraulic Laboratory can now test homologous model turbines under controlled conditions that *duplicate* those found in the prototype installations. This is a substantial stride forward in hydraulic turbine research, since the complete reproduction of actual field conditions has not previously been possible.

The outstanding features of this new facility are:

- World's highest artificial testing head.
- Flows of 5,000 g.p.m. under 300-foot head, and 21,000 g.p.m. under 100-foot head.
- 300 H.P., 0 to 6,000 R.P.M., eddy current dynamometer.
- 100-ton water cooling system to maintain prototype water temperature.

Both basic research and formal contract acceptance tests are performed here. Test stand equipment permits testing of all Kaplan and Propeller, as well as many Francis turbine designs, under conditions of *head* and sigma that *duplicate* those found in the field. This provides a high degree of testing accuracy and permits accurate testing of settings that cannot be satisfactorily field tested.

For further information on the significance of this high head test stand, write to S. Morgan Smith Co., York, Pa.



Pump Head-discharge Curves for Series and Parallel Operation.

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Non-ASCE Meetings

American Concrete Pipe Association. Sixth Annual Short Course School of Instruction at the Chase Hotel, St. Louis, Mo., October 29, 30 and 31. Information from Howard F. Peckworth, Managing Director, ACPA, 228 North LaSalle Street, Chicago 1, Ill.

American Institute of Chemical Engineers. Special Symposia at the Penn-Sheraton Hotel, Pittsburgh, Pa., September 9–12. Information from Clark Holloway, Jr., P. O. Drawer 2038, Pittsburgh 30, Pa. Reservations can be made directly to the Penn-Sheraton Hotel.

American Concrete Institute. 1956 Regional Meeting to be held at Mount Royal Hotel, Montreal, Canada, October 24–25. Further information from Robert E. Wilde, ACI, 18263 West McNichols Road, Detroit 19, Mich.

American Public Works Association. Sixty-Second Annual Public Works Congress and Equipment Show at the Will Rogers Memorial Auditorium and Coliseum and Exhibit Building, Fort Worth, Tex., September 23–26. Information from APWA, 1313 East 60th Street, Chicago 37, Ill.

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Hercules couldn't match the tremendous bridge-lifting strength of EARLE operating machinery
Earle Operating Machinery, now in use in many of the nation's finest movable bridges, is renowned for its dependable power, long-life and economical operation. Machinery is another member of the famous Earle line of precision-made products which include gears and speed reducers.
Write Today For Catalogs
The EARLE Gear and Machine Co.
4707 Stenton Avenue
Philadelphia 44, Pa.

American Road Builders' Association. Fourth Annual National Highway Conference for County Engineers and Officials at Grand Hotel, Mackinac Island, Mich., September 17–19. Information from ARBA, World Center Bldg., Washington 6, D. C.

American Society for Metals. Thirty-eighth National Metals Congress and Exposition to be held in Chicago, October 8–12. Information from Chester L. Wells, Director, National Metals Congress and Exposition, 7301 Euclid Avenue, Cleveland 3, Ohio.

American Society for Testing Materials. Second Pacific Area National Meeting and Apparatus Exhibit at Hotel Statler, Los Angles, Calif., September 17–21. Information from John B. Howe, Chairman, ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Welding Society. Fall Meeting at Hotel Cleveland, Cleveland, Ohio, October 8–12. Information from J. G. Magrath, Secretary, American Welding Society, 33 W. 39th Street, N. Y.

American Society of Mechanical Engineers. 1956 Fall meeting at the Cosmopolitan Hotel, Denver, Colo., September 10–12. Information from W. K. Sutherland, 847 Pearl Street, Denver 3, Colo.

Engineers Joint Council. Pan-American Federation of Engineering Societies (UPADI) will hold its Fourth Convention in Mexico City, October 8–12. Information from Brig. Gen. S. E. Reimel, Committee on International Relations, EJC, 29 West 39th Street, New York 18, N. Y.

Engineers' Council for Professional Development. Twenty-fourth annual meeting at the Engineering Society of Detroit, 100 Farnsworth Avenue, Detroit, Mich., October 25–26. Hotel headquarters at the Statler Hotel. Information from S. L. Tyler, Executive Secretary, ECPD, 29 West 39th Street, New York 18, N. Y.

Federation of Sewage and Industrial Wastes Associations. Twenty-ninth Annual Meeting at Statler Hotel, Los Angeles, Calif., October 8–11. Information from FSIWA, 4435 Wisconsin Avenue, N. W., Washington, 16, D. C.

Illinois Institute of Technology. Second Annual Computer Applications Symposium sponsored by Armour Research Foundation of Illinois Institute of Technology at the Morrison Hotel in Chicago, Ill., October 9–10. Information from J. J. Kowal, Conference Secretary, Armour Research Foundation, 10 W. 35th Street, Chicago 16, Ill.

Institute of Traffic Engineers. Twenty-sixth Annual International Convention at the Mark Hopkins Hotel, San Francisco, Calif., September 24–28. Information from Bob Glenn, General Chairman, ITE Annual Meeting, Institute of Transportation & Traffic Engineering, University of California Field Station, Richmond, Calif.

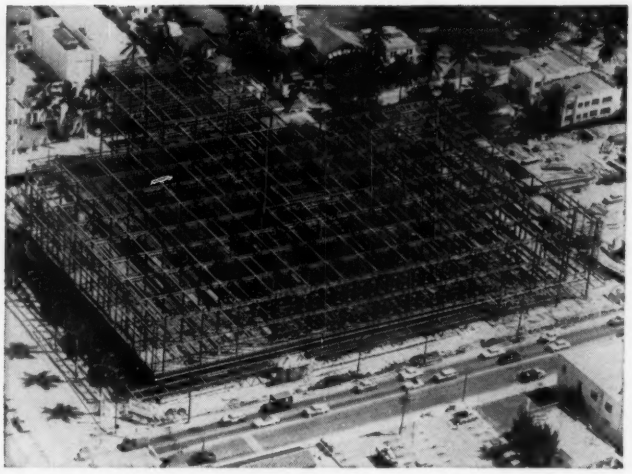
(*Continued on page 112*)

When a welded frame building has more useable space...

Has far simpler connections...

Yet uses less steel...

WHY don't you design all buildings for welded construction



1200-ton all-welded framework for Jordan Marsh Department Store, Miami, Florida.

FIELD WELDING 1200-TON FRAME SIMPLIFIES AND SPEEDS ERECTION

of new Jordan Marsh Store

BY the use of fast, efficient field welding methods, substantial savings in material and cost have been realized on the new $5,000,000 Jordan Marsh Miami Store.

Beam-to-column connections were designed to permit fast, easy down-hand welding on essentially all joints. Connections for bottom flange of beams are shop welded to the column. In erection, beams are rested on these bottom flange connections. Top flange connections are field welded—butt welded to column flange and fillet welded to beam flange.

Fabricators and erectors: Lehigh Structural Steel, Allentown, Pa.; Structural Engineers: Jorgensen and Schreffler, Miami; Architects: Weed, Russell and Johnson, Miami.

Studies in Structural Arc Welding are available to architects and structural engineers. Write:

THE LINCOLN ELECTRIC COMPANY

The World's Largest Manufacturer of Arc Welding Equipment

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SAVES TIME ON VENT LINES

Naylor Spiralweld pipe is "made-to-order" for ventilating jobs in construction service.

Its light-weight makes for easy handling. It saves time on installation . . . especially with the one-piece Naylor Wedge-Lock coupling which can be joined with only a hammer. Lines hug the wall . . . can be assembled with only one side of the pipe in the open . . . and extended readily as work progresses.

You save money, too, because the greater collapse strength inherent in the Naylor structure permits the use of lighter gauge material without sacrifice of performance.

Write for the complete story. Ask for Bulletins No. 507 and No. 514.

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1281 East 92nd Street
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Non-ASCE Meetings

(*Continued from page 110*)

Instrument Society of America. Eleventh Annual Instrument-Automation Conference and Exhibit (International) at the New York Coliseum, New York, N. Y., September 17–21. Information and registration from the Instrument Society of America, 313 Sixth Avenue, Pittsburgh 22, Pa.

Office of Naval Research. Symposium on Naval Hydrodynamics, sponsored by the Office of Naval Research (Mechanics Branch) in cooperation with the National Academy of Sciences, Washington D. C., September 24–28. Information from John S. Coleman, National Academy of Sciences, Washington 25, D. C.

Atomic Industrial Forum. Annual meeting at the Morrison Hotel, Chicago, Ill., September 25–27. Information from AIF, 260 Madison Ave., New York 16, N. Y.

Building Research Institute. BRI Modern Masonry Conference sponsored by the Allied Masonry Council will be held in Washington, D. C., September 25–26. Information from C. E. Silling, Chairman, C. E. Silling & Associates, Charleston, W. Va.

Producers' Council, Inc. Thirty-fifth Annual Fall Meeting and Chapter President's Conference at the Wade Manor Hotel, Cleveland, Ohio, September 25–26. Information from the Producers' Council, Inc., 2039 K. Street, Northwest, Washington 6, D. C.

Seventh Alaskan Science Conference. Sponsored jointly by the Alaska Division of the American Association for the Advancement of Science, American Society of Civil Engineers and the Alaska Chapter of the Society of American Foresters at Juneau, Alaska, September 27–30. Information from C. Howard Blatzo, General Chairman, Seventh Alaskan Science Conference, Fish and Wildlife Service, Juneau, Alaska.

News of Engineers

(*Continued from page 33*)

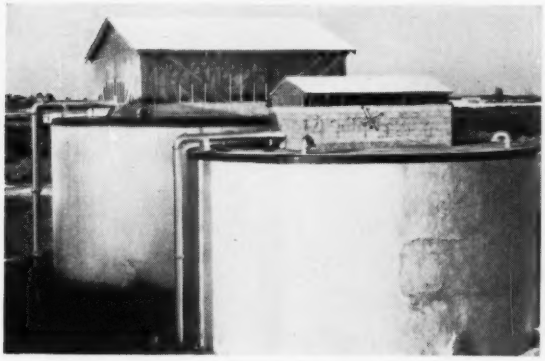
Harry O'Bannon Bellinger has assumed the dual title of Director of Public Works and City Engineer of Columbia, S. C. He had served as acting director since 1948. Mr. Bellinger, has been engaged in municipal government service since 1929, and prior to that was resident engineer for the county and state highway departments. He is state chair-

H. O'B. Bellinger

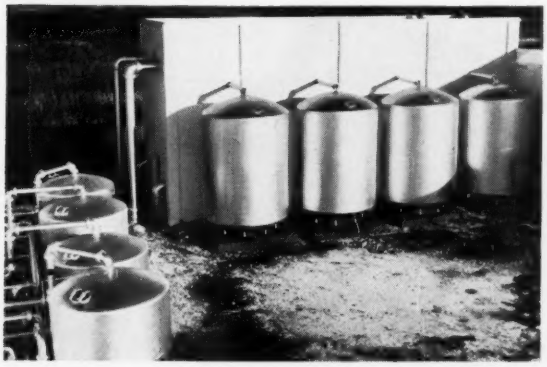
(*Continued on page 114*)

HOLLYWOOD (*Florida*) SAVES $32,980 A YEAR
regenerating its softeners with sea water

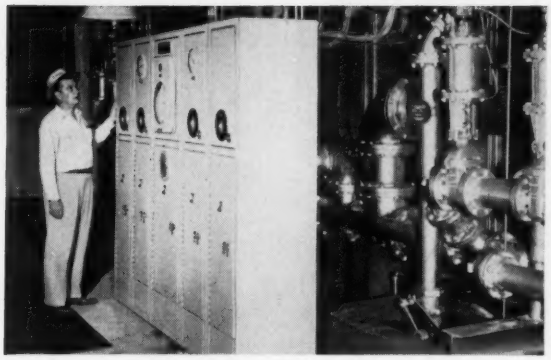
1. Pumps draw sea water from wells beneath this station. Being inland, these wells deliver a partially filtered sea water. (Regenerating costs are now $25 less per million gallons than when dry salt was used.)



2. To prevent marine growths which would foul equipment, the sea water is aerated and chlorinated.



3. Sea water then passes through Permutit pressure filters (left) and is ready for regenerating the Permutit softeners (right). Sea water pumpage is kept to a minimum because high-capacity Permutit Q, used in the softeners, requires less salt for regeneration.



4. City Engineer George A. Gieseke inspects the Permutit control panel. It backwashes, regenerates and rinses the 4 newest softeners and places them on the line . . . *all without aid from the plant operator!* Two men per shift operate the entire water plant.

5. Hollywood is growing fast. Their first four Permutit softeners went on the line twenty years ago. Now there are 12 . . . and plant space for more. "We're in good shape," says City Engineer Gieseke.

It's easy to see why Consulting Engineers *Reynolds, Smith & Hills* chose Permutit equipment . . . for its long service life and low operating costs. And we'll be glad to help you make sure your water supply is "in good shape" for the future. Write to: Dept. C-9, The Permutit Company, 330 West 42nd Street, New York 36, New York.

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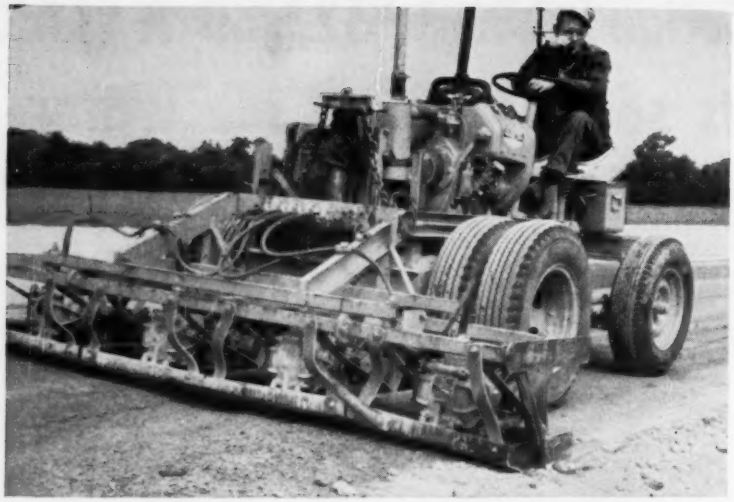


JACKSON MULTIPLE COMPACTOR PROVED ON HUNDREDS OF PROJECTS

THE FASTEST, MOST ECONOMICAL AND VERSATILE MACHINE FOR OBTAINING 100% OF REQUIRED DENSITIES IN GRANULAR SOIL BASES, SUB-BASES AND ALL MATERIALS NORMALLY USED IN MACADAM BASES AND PAVEMENT WIDENING PROJECTS . . . LARGE FILLS AND SIMILAR JOBS. *EACH OF THE SIX UNITS IN STANDARD WORKHEAD DELIVERS 4200 TWO-TON BLOWS PER MINUTE.*

The Jackson Multiple will save you many, many times its cost in time and money. See it at your nearby distributor. His name and literature on request.

The photo above shows the perfect adaptability of the Jackson Multiple Compactor to pavement widening by grouping and towing individual compacting units at the side of tractor for one-pass, complete consolidation on practically every project. At left, see how the end unit on a base compacting job assumes the correct position without adjustment to contain and compact the base edge simultaneously with horizontal base compaction.

Furthermore, individual units may be fitted with operating handles and used exactly like the highly popular, standard Jackson Manually Guided Compactors for getting into the tight places that no other mechanical compactors will reach.

JACKSON VIBRATORS, INC. LUDINGTON MICHIGAN

News of Engineers

(*Continued from page 112*)

man of the American Public Works Association.

William M. Cooper, Jr., has been selected as a group head in the mechanical engineering section of the design division of Esso Research and Engineering Company. Since joining Esso Engineering in 1951, Mr. Cooper has had a number of overseas assignments in Germany and Italy.

Hazelet & Erdal, consulting engineers of Louisville, Ky., have admitted **Lewis G. Hexem, Robert H. Wood, John H. Clark, III, F. Spencer Weber,** and **Frederick A. Reickert** to their partnership. All are members of ASCE. **Craig P. Hazelet** and **A. L. R. Sanders** head the firm, which also has offices in Chicago, Cincinnati and Lansing.

George H. Hickox, formerly program director for engineering sciences with the National Foundation, has been named director of research at the Army Corps of Engineers Research and Development Laboratories, Fort Belvoir, Va. His appointment completes a newly-established three-man civilian directorate. Dr. Hickox has had a distinguished career in research, including six years as associate director of the University of Tennessee Engineering Experiment Station and thirteen years in charge of the TVA hydraulic laboratory.

George H. Hickox

William Augustus Brown, associate engineer in the drones and missiles department of the Sperry Gyroscope Company, Great Neck, N. Y., will return to his alma mater, Manhattan College, this month as an instructor in structural analysis and design. A 1954 graduate of Manhattan, Mr. Brown won a master of science degree in applied mechanics in 1955 at Virginia Polytechnic Institute where he was elected a member of the honor Society of Sigma Xi.

New Publications

Highway research . . . Continuing progress in development and installation of vertical sand drains for stabilization of embankments is detailed in Bulletin 115 of the Highway Research Board. The 52-page illustrated bulletin includes five papers ranging in subject from technological to economic aspects. Copies are 90 cents each, and may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

Structural design . . . For the convenience of engineers, students, and draftsmen, wishing to keep to a minimum the detail work of structural design, James J. Kerley, Jr., has made available design nomographs in a simple descriptive form. In-

quiries about the publication, entitled "Structural Design Nomographs," should be addressed to Mr. Kerley at 6203 Forest Road, Cheverly, Md.

Water resources . . . Ample local water supplies for the foreseeable future are available in southeastern Florida, if they are properly developed and protected. This is the conclusion of a detailed report, entitled "Water Resources of Southeastern Florida." The report, carrying specific reference to the geology and ground water of the Miami area, is a 965-page volume with charts and maps, covering studies made over a period of years by the Geological Survey. Cooperating agencies were the Florida Geological Society, Dade County, and the cities of Miami, Miami Beach, and Coral Gables. Copies may be purchased from the U. S. Government Printing Office, Washington 25, D. C., at $6.50 each.

Construction equipment standards . . . Just off the press are revisions of two AGC standards of continuing interest to construction engineers and contractors. These are the 22nd revision of "Concrete Mixer Standards" and the tenth revision of "Contractors Pump Standards." Request for copies should be made to the Associated General Contractors of America, Inc., Munsey Building, Washington 4, D. C.

Concrete and concrete aggregates . . . Numerous innovations in concrete technology and testing are covered in "Significance of Tests and Properties of Concrete and Concrete Aggregates," which has been released as ASTM Special Technical Publication No. 169. The scope of the present 393-page volume has been expanded greatly over earlier editions (1935 and 1943), which dealt only with significance of tests of concrete. Copies are for sale by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $6 for cloth-bound editions and $5.25 in paper covers.

Highway research . . . Three new pamphlets describing different highway studies are available from the Highway Research Board, 2101 Constitution Avenue, Washington, D.C. Bulletin 111 discusses factors related to frost action in soils and sells for $2.25; Bulletin 113, dealing with land acquisition, is priced at $1.80; and Bulletin 114, covering the design and testing of flexible pavements, is $1.65.

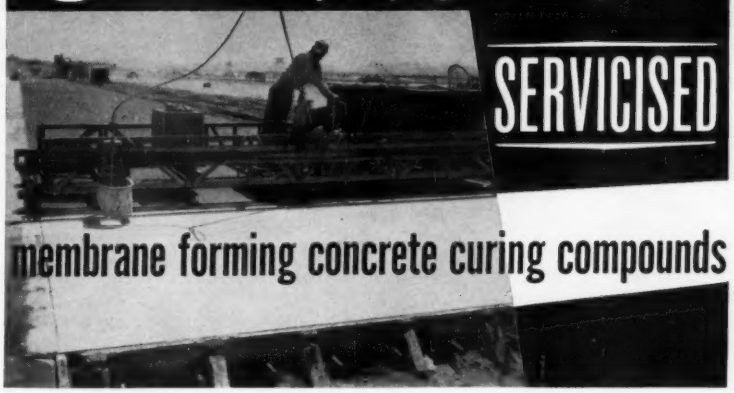
Structural design . . . A second edition of a practical handbook of structural engineering, written by Thomas H. McKaig and entitled "Applied Structural Design of Buildings," is now available. Offering simple, standardized procedures for solving structural problems, this comprehensive reference includes tables, charts, methods, and short-cuts the author has found helpful in 35 years as head of a prominent Buffalo engineering firm. It is written as an aid for persons preparing for state licensing examinations as well as for the practicing engineer and designer. The 442-page publication sells for $12.50. The publisher is the F. W. Dodge Corporation, 119 West 40th Street, New York 18, N. Y.

Heating and ventilating . . . Latest technical and equipment information on heating, ventilating, and air conditioning is available in the 1956 Guide of the American Society of Heating and Air-Conditioning Engineers. The technical data section of this 34th edition contains 1,176 pages. The catalog data section describes the products of 335 manufacturers. Particular attention has been given to the presentation of heat transmission coefficients of building materials. Copies of the Guide, priced at $12 each, are available from the American Society of Heating and Air-Conditioning Engineers, 62 Worth Street, New York 13, N. Y.

Traffic engineering . . . The moving-car method for estimating traffic volumes and speeds quickly, economically, and accurately is offered in a 32-page illustrated study released by William J. Mortimer, superintendent of highways for Cook

(*Continued on page 116*)

6 reasons for specifying and using SERVICISED membrane forming concrete curing compounds



1. **Provide lowest unit of moisture loss**
2. **Meet official specifications for each particular type**
3. **Sprayed or painted on vertical surfaces, they will "stay put"**
4. **Save time, labor, material**
5. **Will not cake in the drum**
6. **Guaranteed uniform quality and results**

WHITE PIGMENTED TYPE Servicised White Pigmented Curing Compound provides a film or membrane capable of reflecting heat. It is widely used in areas where atmospheric temperatures exceed 80°F., and properly applied, will reduce concrete temperatures approximately 15°F. Excessively high temperatures during the early hardening period tend to jeopardize setting of concrete and reduces its final strength. High quality inert pigments added to the basic compound also prevent too thin or uneven coverage, as improper application is readily seen. Used on all U. S. Engineers work.

CLEAR TYPE Servicised Clear Curing Compounds are available in both Wax-Resin and Resin Base Types. Only pure synthetic resins are used with carefully controlled proportions of oils and waxes, etc., in a petroleum solvent to insure a clear, impermeable membrane. Both types can be supplied with a fugitive dye which materially assists in securing proper coverage, and which disappears after application.

WAX-RESIN BASE. A general purpose compound, usually used on mass concrete, pavements. Has excellent water retention properties, allowing slow curing of the concrete which eliminates checking. Dries rapidly and forms a film of uniform texture.

RESIN BASE. Recommended for buildings, offices, architectural concrete, etc. The pure resins, oils and other ingredients present a clear film which does not materially alter the appearance of concrete and it permits early application of adhesives, paint, etc.

AIR ENTRAINING AGENT Servicised Air Entraining Agent is a highly active, homogenous and clear solution. A relatively small quantity produces maximum air dispersion, yet it is not so critical as to create wide fluctuations in the amount of entrained air should slight variations in the amount used occur. It will not settle out in storage or gum the dispenser, and its action is not jeopardized by the presence of Calcium Chloride. Servicised Air Entraining Agent meets all official specifications, comes ready to use and requires no additional ingredients or treatment before being used. Available in 5 gallon and 55 gallon drums.

Write for special circulars on Curing Compounds and Air Entraining Agent

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Paragon® gives you speed ... without fatigue!

Check the response-to-the-touch. You can actually feel the difference!

That's why the Paragon Drafting Machine noticeably cuts end-of-the-day fatigue . . . saves costly man hours . . . helps raise working standards.

See how easily protractor control ring can be reached—no matter what position your hand is in. Another time saver. Touch that ring with your *little* finger and scales rotate freely. Release pressure and scales automatically lock to nearest 15° position. And intermediate angles are just as easily set!

Top day-to-day performance is guaranteed by unique "open center" design of arms which protects smooth-working factory-set band tension.

A good look at a Paragon and a touch on that control ring is worth 1,000 words! Try it before you buy *any* drafting machine—you can *feel* the difference.

89 YEARS OF LEADERSHIP

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New Publications

(*Continued from page 115*)

County, Illinois. Inquiries should be addressed to Mr. Mortiner at 130 N. Wells Street, Chicago 6, Ill.

Water treatment . . . Progress in the fight against pollution is the essential theme of the Proceedings of the Fourth Annual Ohio Water Clinic, held at Ohio State University in February 1955. The university, together with nine local and state groups concerned with good water, sponsored the two-day program, which presented much timely information. Inquiries about the proceedings should be addressed to the Division of Water, Ohio Department of Natural Resources, Columbus, Ohio.

Cement standards . . . Issuance of a new Standard on Cement, identified as C-1, is announced by the American Society for Testing Materials. The 273-page compilation covers the various ASTM standards and tentative specifications, methods of chemical analysis, and physical tests. It sells for $2.75, and may be obtained from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa.

Applications for Admission to ASCE July 14–Aug. 11, 1956

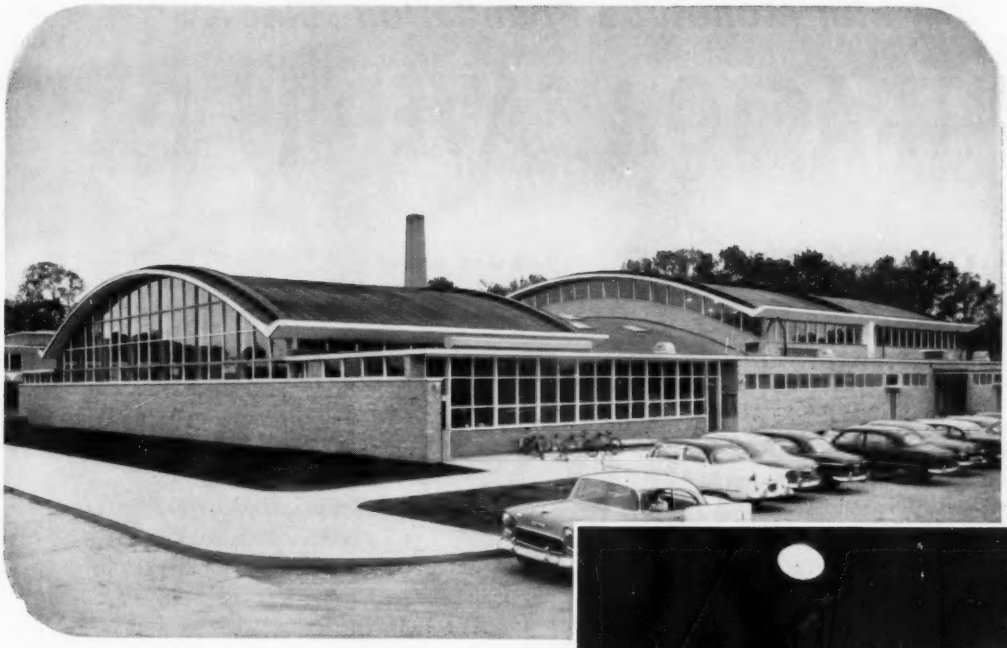
Applying for Member

LEIGH BLANTON BARRETT, Alexandria, Va.
ROBERT RUSSELL CAMPBELL, San Diego, Calif.
ROBERT HAXTON CAREW, Pittsburgh, Pa.
EUDORO OCTAVIO CEVALLOS DE LA JARA, Guayaquil, Ecuador
WILLIAM GAMBLE GORDON, Arlington, Va.
NARHAR SAWALARAM GUPCHUP, Bombay, India.
JAMES HALLETT HERENDEEN, Harrisburg, Pa.
HENRY HOWARD LIST, Houston, Tex.
ROBERT LEONARD LITTLE, Roanoke, Va.
JOHN MILLER MUDDEMAN, Long Island, N. Y.
DANIEL ALLEN RICHARDS, Omaha, Nebr.
SYDNEY HIRAM STILLEY, Jacksonville, Fla.
SANTIAGO ENRIQUE VERA, Caracas, Venezuela.
DONALD BURNS WILLIAMS, Buffalo, N. Y.

Applying for Associate Member

SEWARD LOUIS ANDREWS, JR., Bukavu, Belgian Congo.
MILTON EDWIN BENDER, JR., Fort Collins, Colo.
RUSSELL ROSS CLAAR, Richland, Wash.
MARLYN EARL CLARK, Urbana, Ill.
ROBERT ANTHONY CUEVAS, Miami, Fla.
HANSJORG PAUL DANDLIKER, New York, N. Y.
JOHN PAUL DEMARCUS, Knoxville, Tenn.
DONALD GEORGE EAGLING, Toledo, Ohio.
HAROLD YIN GECK FONG, San Francisco, Calif.
RICHARD GARNJOST, Lima, Ohio.
ROBERT ALUE GERBER, Jackson, Miss.
ROBERT MACK GILLIM, Louisville, Ky.
WILLIAM DENZIL GOBBART, Tasmania, Australia.
MIGUEL ANTONIO GONZALEZ-JAIMES, Merida, Venezuela.
ASHER GRUENBERG, Skokie, Ill.
WILTON NEWTON HAMMOND, Fort Worth, Tex.
A. WEBB HART, JR., Alliance, Ohio.
CHARLES JACKSON HAVER, Pasadena, Calif.
RALPH EUGENE HAVERKAMP, Sacramento, Calif.
WASFI AHMAD HIJAB, Beirut, Lebanon.
CLARENCE RAYMOND HOIDAL, Seattle, Wash.
RAFAEL FRANCIS JIMENEZ, Richland, Wash.
OLOF FABIAN JOHNSON, San Francisco, Calif.
ROGER HENRY KADALA STEARN, Caracas, Venezuela.
EDWIN WOODROW LARSON, Portland, Ore.
DONALD AUBRY LOCKHEAD, Montclair, N. J.
WILLIAM HARLEY LONGMIRE, San Francisco, Calif.
HARRY HUAN-YEN LOO, Newark, N. J.
ROBERT JOSEPH LOWE, Port Hueneme, Calif.
NEIL EGBERT MACDOUGALL, San Gabriel, Calif.
LUTHER WYLIE MATTHEWS, Vicksburg, Miss.
STAFAN JERZY MEDWADOWSKI, Berkeley, Calif.
KENNETH IRWIN MULLEN, Pasadena, Calif.
GALE ANTHONY O'CONNELL, Balboa Heights, Canal Zone.
JOHN RUFFNER PAGE, Norfolk, Va.
GUS JOHN PAPPAS, Champaign, Ill.
IRVIN SCOTT POEHLMAN, Towson, Ariz.
ASBURY WILLIAM QUILLIAN III, Morristown, Tenn.
AHMED ALI SABER, Los Angeles, Calif.
WARREN PAUL SCHILLING, Miami, Fla.

(*Continued on page 135*)



Design of Edsel Ford High School features distinctive, economical

Concrete Shell Roofs

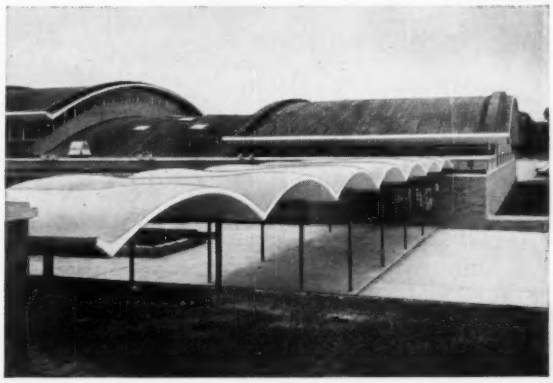
The first concrete shell roofs constructed in Michigan were used in the Edsel Ford High School in Dearborn. Four shell units were built: two over the boys' gym, one over the girls' gym, and a fourth over an intermediate building housing the swimming pool and locker rooms. All four roofs have spans of 100 ft. and identical arches of 121-ft. radius and a rise of 13 ft.

Concrete shell roof construction was selected because (1) it provided unobstructed interiors, (2) it was adaptable to the architectural design and (3) it was economical to build.

Concrete shell roof construction is gaining rapidly in popularity with architects and engineers for buildings requiring large unobstructed floor areas. Roofs with spans up to 300 ft. and more can be built without interior columns. They are ideal for auditoriums, exhibit halls, hangars, train sheds, repair shops and warehouses.

Concrete shell roofs are economical to build, need little or no maintenance, have long life and low insurance rates. They are true *low-annual-cost* construction. Write for free illustrated literature. Distributed only in the United States and Canada.

Large photo shows completed structure. Girls' gym is in foreground, boys' gym in rear. Depressed roof between gyms covers swimming pool and locker rooms. Small photo above shows clean, unobstructed interior in boys' gym. Photo below shows how shell roof design was repeated in roof over walk connecting gymnasium wing with auditorium. Architect, Eberle M. Smith Associates, Inc.; engineer, Alfred Zweig; contractor, O. W. Burke Construction Co. All are from Detroit.



PORTLAND CEMENT ASSOCIATION

Dept. 9-13, 33 West Grand Avenue, Chicago 10, Ill.

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

with Monotube Foundation Piles...

CONTRACTOR SAVED 19 DAYS

PILE DATA

Type—Monotube
Diameter—12 inch
Gage—7
Number of piles—1438
Length—up to 90 feet

Constructed for:
United Illuminating Co.,
Bridgeport, Conn.

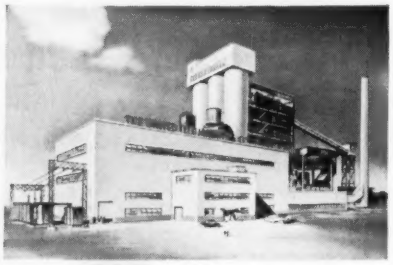
Engineers:
Jackson & Moreland, Inc.,
Boston, Mass.

General Contractor and Foundation Contractor:
C. W. Blakeslee & Sons,
New Haven, Conn.

One of the two standard rigs, shown here driving batter piles. Any specified batter is easily met with Monotubes.

Here's economy in industrial work.

Light weight, easy handling and fast field-splicing of Monotube piles helped this contractor reduce anticipated driving time by 19 days. Piles were driven at the rate of 2500 feet per shift using two rigs. Learn how Monotubes can help *you* save time, cut cost. Write The Union Metal Manufacturing Company, Canton 5, Ohio, for detailed catalog information.



Architect's rendering of Bridgeport Harbor generating station, Bridgeport, Conn.

50 FIFTIETH ANNIVERSARY 1906-1956

UNION METAL
Monotube Foundation Piles

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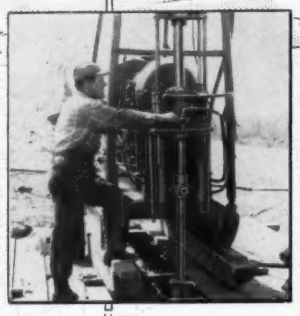

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Many, many firms throughout the United States and the world know the advantages of core drilling; and Sprague & Henwood, with more than 70 years of experience, is the leader in this field. Sprague & Henwood crews have completed thousands of contracts successfully in every conceivable condition. For the best in exploratory core drilling (surface or underground), blast hole drilling, directional drilling, foundation test drilling, grout hole drilling, and pressure grouting—be sure to call Sprague & Henwood. Estimates and suggestions given without charge.

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DOUBLE-TUBE REAMING SHELL

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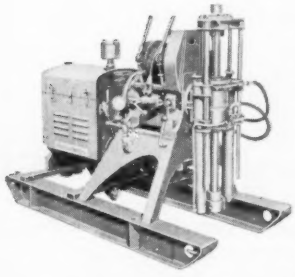
Any bit you buy will work for a while. But if you specify or order Sprague & Henwood "Oriented" Diamond Bits, giving all information on your drilling conditions, you will receive the bit or bits that will do the best job for you. Lower your cost per foot, with a minimum of diamond loss. Write today for complete "Oriented" Diamond Bit Bulletin #320-1.

RESETTING SERVICE

Send in your bits that need resetting, giving full details of results obtained and conditions under which bits were used. They will be returned new—and "Oriented" to give you less diamond loss and lower your cost per foot.

FIELD TESTED DRILLING MACHINES

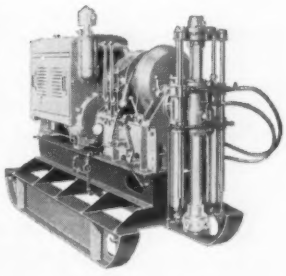


MODEL 40-C CORE DRILL MACHINE

Field Tested means just that . . . with contract work being done under every conceivable condition, Sprague & Henwood drilling machines have to perform right. Different sizes and types to meet various conditions are available. Your conditions should be given in detail, and recommendations will be forwarded to you immediately, without cost.

ACCESSORY EQUIPMENT

In addition to drilling machines, and diamond bits, Sprague & Henwood manufactures and can supply you with a complete line of accessory equipment necessary to make up a drilling outfit, such as drill rods, core barrels, casings, fishing tools, etc. A new and most complete Catalog, No. 400, listing all accessory equipment is available to you. Write today for your free copy. It will be mailed promptly.



MODEL 142 CORE DRILL MACHINE

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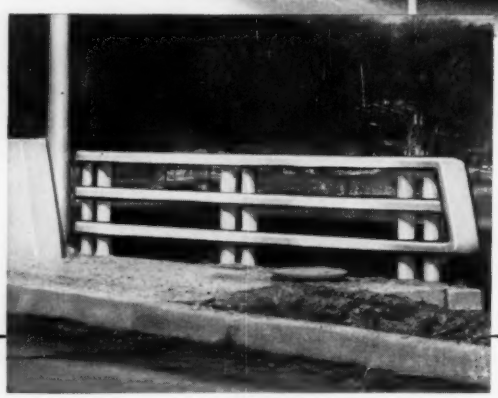
THE MODERN PATTERN IN
RAILINGS AND LIGHTING STANDARDS...

aluminum



Reynolds Aluminum Guard Rails on the A. E. Staley Bridge on Route 36 in Decatur, Illinois.

Contractor and Erector:
M. J. Boyle & Company,
Chicago, Illinois.

Fabricator:
Commercial Shearing and Stampings Inc.,
Chicago, Illinois.

Engineers:
Illinois State Highway Department.

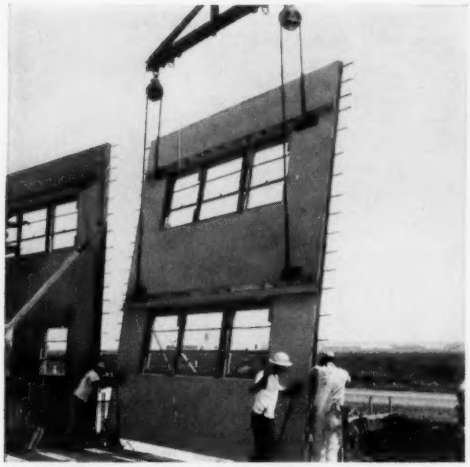
On more and more bridges and viaducts across the country, guard rails and lighting standards attest the beauty of modern design with aluminum. The pattern has become traditional...aluminum for strength, for rustproof permanence without painting, for lower installed cost due to lighter weight and better workability.

In the example shown here, railings and posts are specially cast aluminum. Many other guard rails use standard shapes and tubings. Illustrated booklet on request. For either standard mill products or for special requirements, call the nearest Reynolds Office listed under "Aluminum" in classified directories. Or write to **Reynolds Metals Company,** General Sales Office, Louisville 1, Kentucky.

For quick reference, see catalog $\frac{5a}{Re}$ *in Sweet's Architectural File.*

REYNOLDS ALUMINUM

See "Frontier", Sundays, NBC-TV Network. Starting Sunday, Sept. 23, see Reynolds great new series "CIRCUS BOY"—same time and Station.



PANEL with large window areas

WAREHOUSE

DANIEL CONSTRUCTION CO. PHOTO

Tilt-Up Costs Go Down

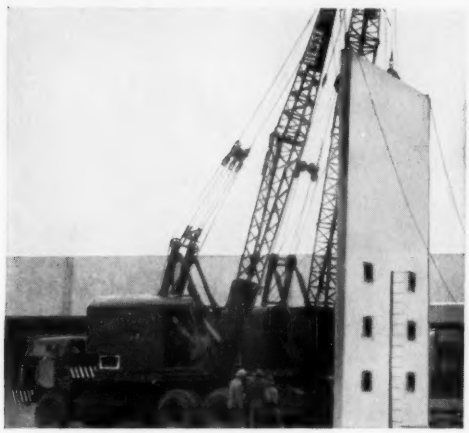
...with SUPERIOR "Pick-Up" Inserts, Brace Anchors, and Braces

When an outstanding Tilt-Up job rates an article in a construction publication you can be almost certain that SUPERIOR products were used. The reason is simple. SUPERIOR, as the pioneer in this field, developed designs that were thoroughly tested both in the laboratory and the field to assure safety with economical prices and low application costs.

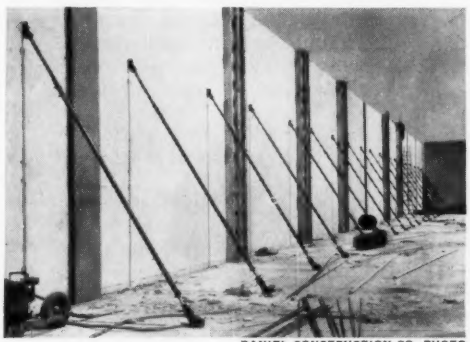
These "Pick-Up" Inserts, Brace Anchors, and Adjustable Braces have been used and proven on literally thousands of projects, not a few of which were unique in design. With a background of such experience, the recommendation of our engineers as to location and types of Inserts and Anchors is reliable and valuable.

Avoid expensive crane delays, be assured of safety, and reduce your overall costs with these SUPERIOR products.

For further details request a copy of Bulletin TU-3



57 TON SLAB being positioned



DANIEL CONSTRUCTION CO. PHOTO

ADJUSTABLE BRACES used for quick and easy alignment of panels

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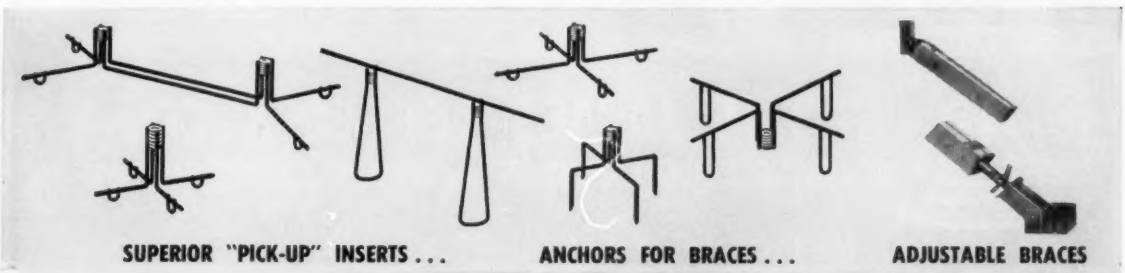
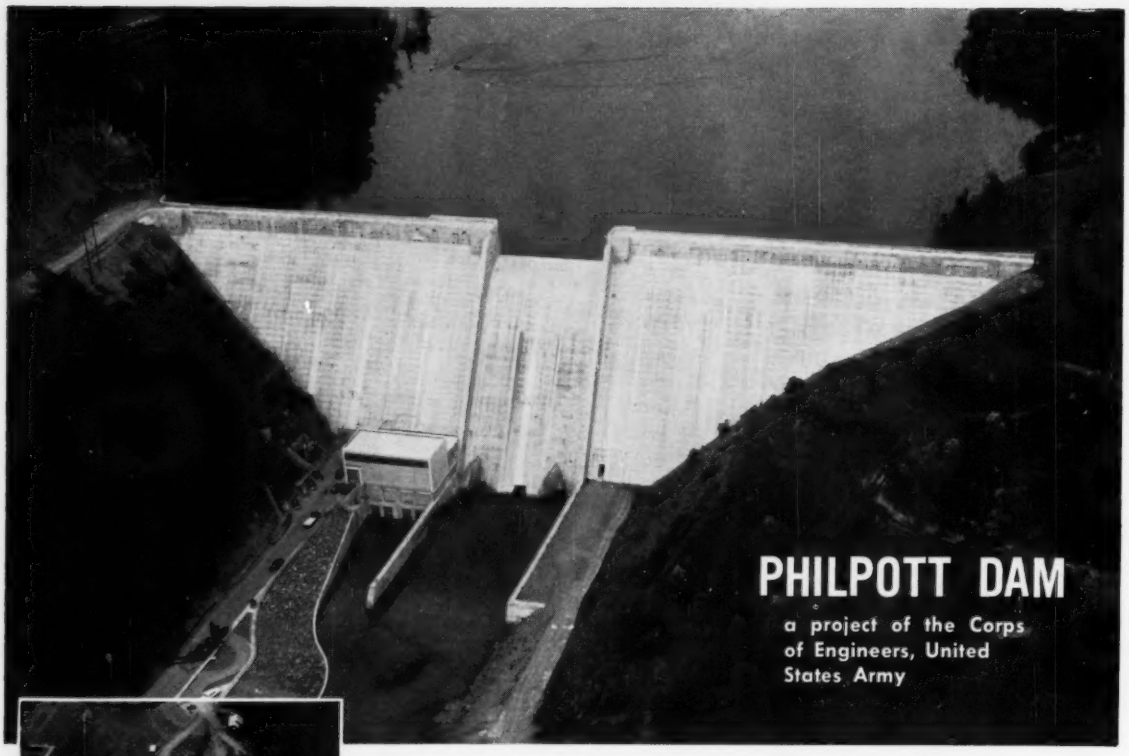
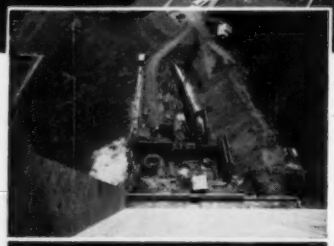
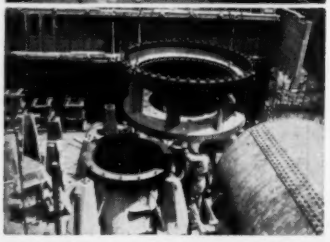


SUPERIOR "PICK-UP" INSERTS . . . **ANCHORS FOR BRACES . . .** **ADJUSTABLE BRACES**







Another Outstanding Installation of **Leffel Hydraulic Turbines**

Philpott Dam, a recent Corps of Engineers, United States Army, project on the Smith River in Henry and Franklin Counties, Virginia, is a site of another outstanding installation of efficient dependable Leffel turbines. The Philpott project was constructed for flood control and hydroelectric power generation. It is one unit of a comprehensive reservoir system planned for the Roanoke River basin.

Three Leffel turbines were installed at the Philpott power plant. Two are each rated at 9400 hp under 152 ft. net head, at a speed of 227 rpm; and the third is rated 860 hp at 720 rpm.

The view above shows the completed project. The views at the left show the project under construction, the spiral casing for one turbine in place, and a stay ring being lowered into place over the draft tube.

Other Leffel installations are dependably and efficiently producing power from water in this country and in all parts of the world. Leffel engineers are waiting to put their 94 years of experience with water power to work for you, whether your project is a completely new installation, or an expansion or rehabilitation of existing facilities. Write today for literature describing Leffel turbines for all hydraulic power requirements and showing a wide variety of outstanding Leffel installations.

1095-E

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 94 YEARS

No "Cure-All," but...

Salinas, California, finds a single grade of Bitumuls® solves five paving maintenance problems

HERE'S A SITUATION common to most growing cities: annexation of outlying residential developments has vastly expanded the street maintenance job *without* materially increasing available funds. Annexation has not only added to the street mileage, but has "contributed" many sub-standard pavements to the street system, thus adding to the complexity of the job.

In an effort to solve this problem, these three Salinas men most directly concerned have worked together: Thomas A. Dunne, Director of Public Service; his assistant, Al Rossi; and Harry Adams, Maintenance Supt. Their search for simplicity and standardization led them to look for a versatile asphalt material that would do many jobs. They found it in Bitumuls SS-1, an asphalt emulsion that can be handled and used without heating, in small quantities or large.

Now, stored in a single 25,000-gallon tank, Bitumuls SS-1 is used for: Patching, Tack Coats, Prime, Seal Coats & Surface Treatments, and for Base Stabilization. In addition, Salinas City Forces can also use this same grade of Bitumuls for the new Slurry Sealing; and—at high dilution – for dust-laying on unpaved, outlying roads. All of these jobs can be done with existing equipment: a grader, a "Pulvimixer", a water wagon, two distributors, and a roller.

The obvious economies resulting from the use of this one material for all these jobs merit investigation by paving maintenance men everywhere, regardless of the size of their community.

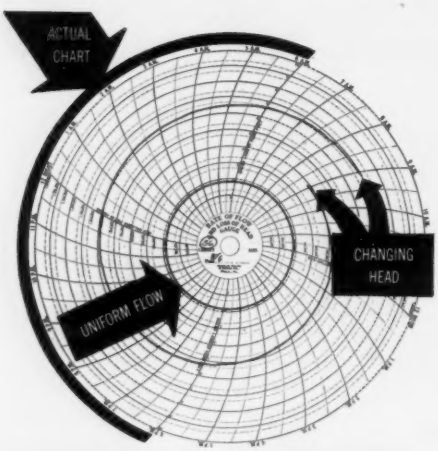
There's a Bitumuls man near you who can supply details. *Call him, today, or write:* **American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.**

(Top), "PULVIMIXER" reworks old pavement that has been scarified and bladed in restabilization operation. Distributor applies Bitumuls at ¾ gal./sq. yd. per inch of depth. (Center), DISTRIBUTOR applies prime on a waterbound base, using Bitumuls SS-1 diluted (2 parts SS-1 to 1 part water) at 0.3 gal./sq. yd. of dilution. (Bottom), HERE'S A CLOSE-UP of the finished texture of a Bitumuls SS-1 Seal Coat pavement.

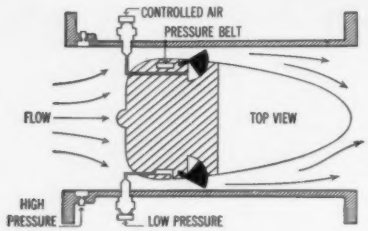
(Right), SALES ENGINEER Bob Ridell, far left, of American Bitumuls & Asphalt Co., discusses plans with Tom Dunne, Director of Public Service for Salinas, and his assistants. At far right is a partial view of the 25,000 gal. storage tank. (Below), EVEN SCHOOL YARDS are given stabilized bases with Bitumuls SS-1.

NEW SIMPLEX FILTER RATE CONTROLLER GIVES YOU COMPLETELY PNEUMATIC CONTROL!

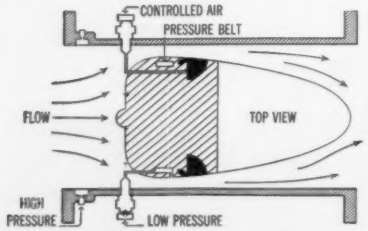
Amazing Modulair® Controller responds fast . . . closes tight



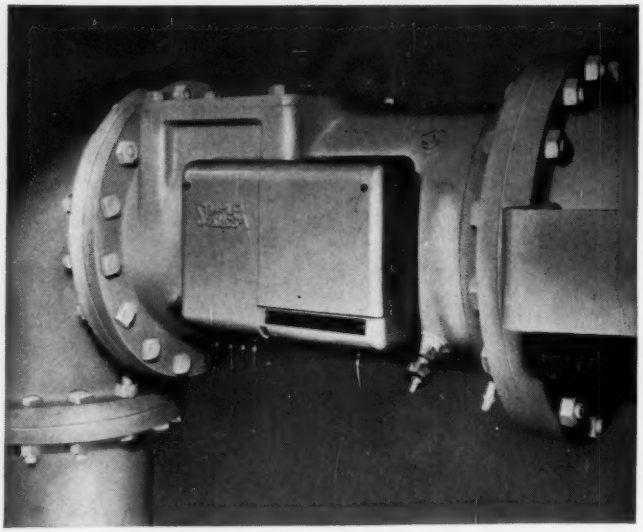
Here's proof that the new Simplex Modulair Filter Rate Controller responds instantly to changes in filter head, holds flow at desired rate . . . automatically! In chart from Modulair installation No. 2, head changes from 4′ to 7′ while rate forms almost perfect circle at the set 275,000 gpd.



How Modulair works! Pipe-like casting with annular Venturi throat houses streamlined inner body with corded-rubber modulator (black) that expands and retracts pneumatically to control flow. When head is low at start of run, modulator expands automatically to hold flow at set rate.



As filter head loss rises, flow tends to decrease . . . and change the Venturi differential. Sensitive Modulair compensates by instantly retracting the pneumatic modulator, maintaining a constant head-loss value through the combined filter and controller, automatically keeping flow at set rate!



Compact . . . easily installed Modulair is only two to three pipe diameters long! It fits wherever a piece of pipe can fit . . . in any position, horizontal or vertical . . . simplifying pipe gallery layout. High-grade, cast iron Modulair comes in 4″ to 24″ standard pipe sizes with corrosion-resisting fittings. Cord-inserted rubber throttling element that's as tough as a truck tire has given 30 years' wear in accelerated life-tests.

Accuracy! In 4 years of field performance, Modulair charts show an accuracy in filter control that exceeds today's most exacting demands. This high degree of control extends for wide ranges of head loss and flow rates, including complete, tight shut-off! And there's no drift at end of run.

Longer filter runs! Modulair combines a low head-loss, annular Venturi measuring element with a streamlined throttling element. This new design offers so little resistance to flow that you get longer filter runs, big savings in wash water!

Minimize maintenance! With Modulair's new design, there's no place for air to accumulate . . . no place for sand to lodge and interfere with accuracy. Throttling element, the only moving part inside pipeline, is non-corrosive rubber. Pneumatic poise element is simple, rugged. There are no line valves, no pilot valves, no pistons, no valve shafts, no stuffing boxes to pack!

Lower first cost! Modulair's low head loss means lower operating head requirements . . . permits vertical compression in plant design and lower costs in plant construction.

Completely pneumatic! No intermediate hydraulic steps! No pilot valves! No hydraulic cylinders! Air loading pressure is applied *directly* to the flow controlling element.

Automatic filter operation! Modulair works with control systems of any type to give you remote rate control or master pneumatic control that's fully automatic.

Technical bulletin! For full details on Modulair, write for Bulletin 950. Simplex Valve & Meter Company, Dept. CV-9, 7 East Orange Street, Lancaster, Penna.

Accurate instruments and controls for over 50 years

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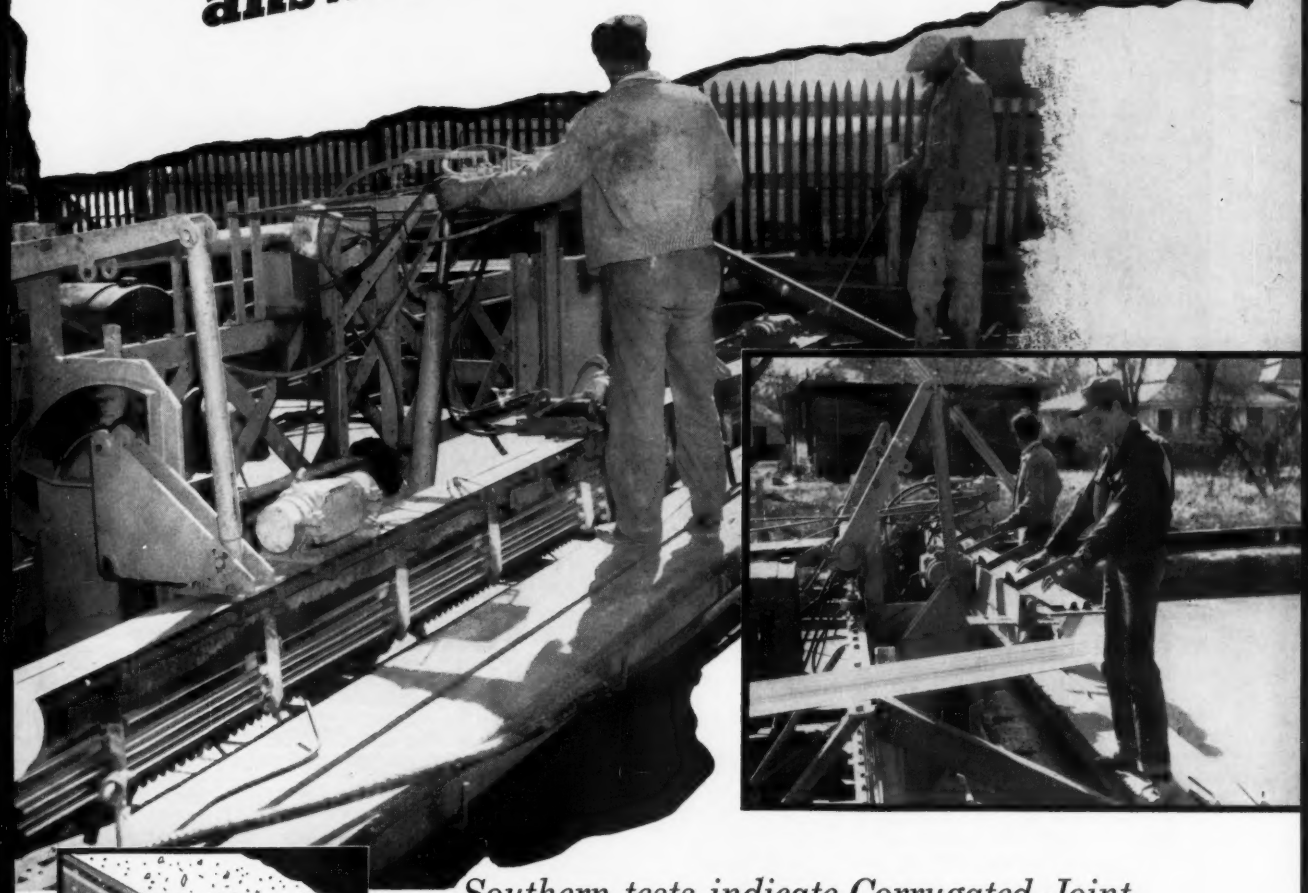
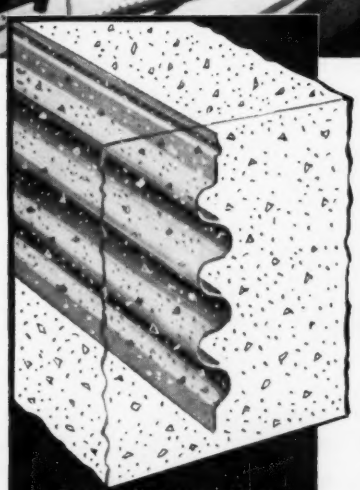
VALVE AND METER COMPANY

Is Corrugated Joint the answer to better highways?





Concrete fills corrugations making a water tight joint that is free to rotate and still maintain load transfer

Southern tests indicate Corrugated Joint best permits expansion and contraction while still providing maximum load transfer!

● Considerable experimentation in the states of Louisiana and Texas has proved some rather interesting points that make the corrugated joint attractive to other highway engineering groups. For example, the corrugated joint permits full joint rotation—slab expansion-contraction action—while providing maximum load transfer at all times. Corrugations actually lock slabs together, yet every point on the joint is always free to rotate. Too, the joint is watertight in itself, without the need for joint compounds that require maintenance and produce certain rough riding qualities. But perhaps the most important advantage of all is the ease of installation. Flex-Plane has been providing all the mechanized equipment since the beginning of the tests, and has recently developed a machine that enables two men to handle the entire jointing operation, making it most economical to use.

For further information write Dept. C-56, Flexible Road Joint Machine Company, Warren, Ohio.

THE FLEXIBLE ROAD JOINT MACHINE COMPANY

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9893

Piling operations at Structure 53-5, Indiana Toll Road. Pile Diameter: 12", Wall Thickness: .172", Hammer: Vulcan No. 1

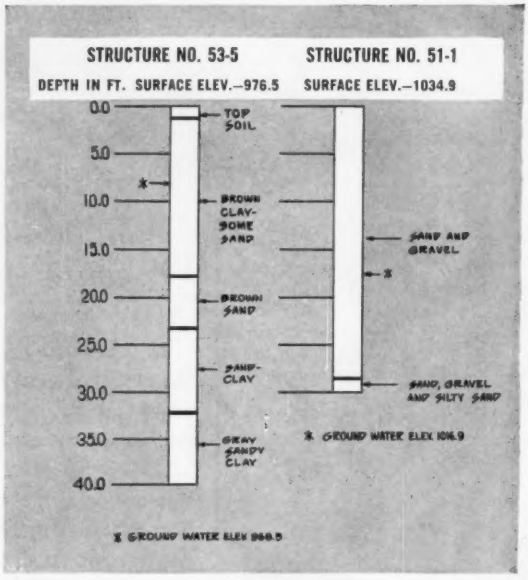
How Armco Pipe Piling Met Varying Foundation Requirements on the Indiana Toll Road

Soil Logs for Typical Grade Separation Structures Illustrate Different Driving Conditions

The soil logs reproduced here illustrate the widely varying conditions encountered at the site of two typical grade separation structures on the Indiana Toll Road. Under structure No. 51-1, hard driving sand and gravel; under structure No. 53-5, relatively easy driving clay.

In both cases Armco Pipe Piling provided the efficient answer. It withstood up to 100 blows per foot to reach the required minimum 20-foot penetration at structure 51-1. In the less stable soil at Structure 53-5, penetrations of more than 40 feet were needed to meet the same 30-ton bearing requirement. The constant cross section of Armco Piling made it easy to splice. Cut-offs could be salvaged. And high collapse resistance assured straight piles, easily inspected for watertightness.

Write us about your foundation problems. Your nearby Armco man will be glad to show you performance data on Armco Pipe Piling in a wide range of driving conditions. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 4756 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.



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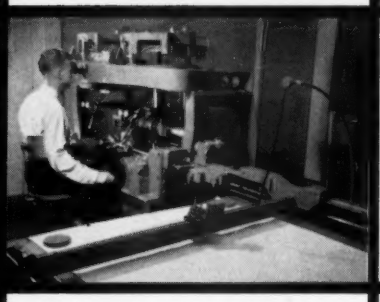

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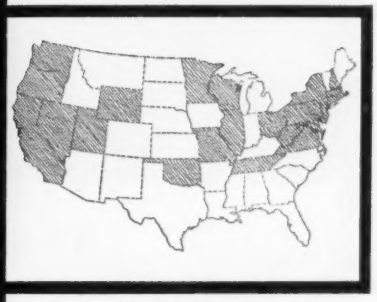

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Steel for the Senators

The Capitol dome provides an imposing backdrop for Bethlehem ironworkers erecting steel for the additional Senate Office Building. Completion of the new structure with its 329 office rooms will mean larger office suites for Senate members. Other much-needed facilities to be provided include committee hearing rooms, a 500-seat auditorium, a spacious cafeteria, a parking garage and gymnasium.

E-shaped in plan, the building is seven stories high, plus a basement and sub-basement, and totals 392,000 sq ft in floor area. Its white marble exterior and over-all architectural design are in harmony with other government buildings.

Location of the new building is just across First Street from the existing Senate Office Building, between Constitution Avenue and C Street, only a short stroll from the Capitol.

Architect: J. George Stewart, Architect of the Capitol; Associate Architect: Otto R. Eggers; General Contractor: The George Hyman Construction Co.

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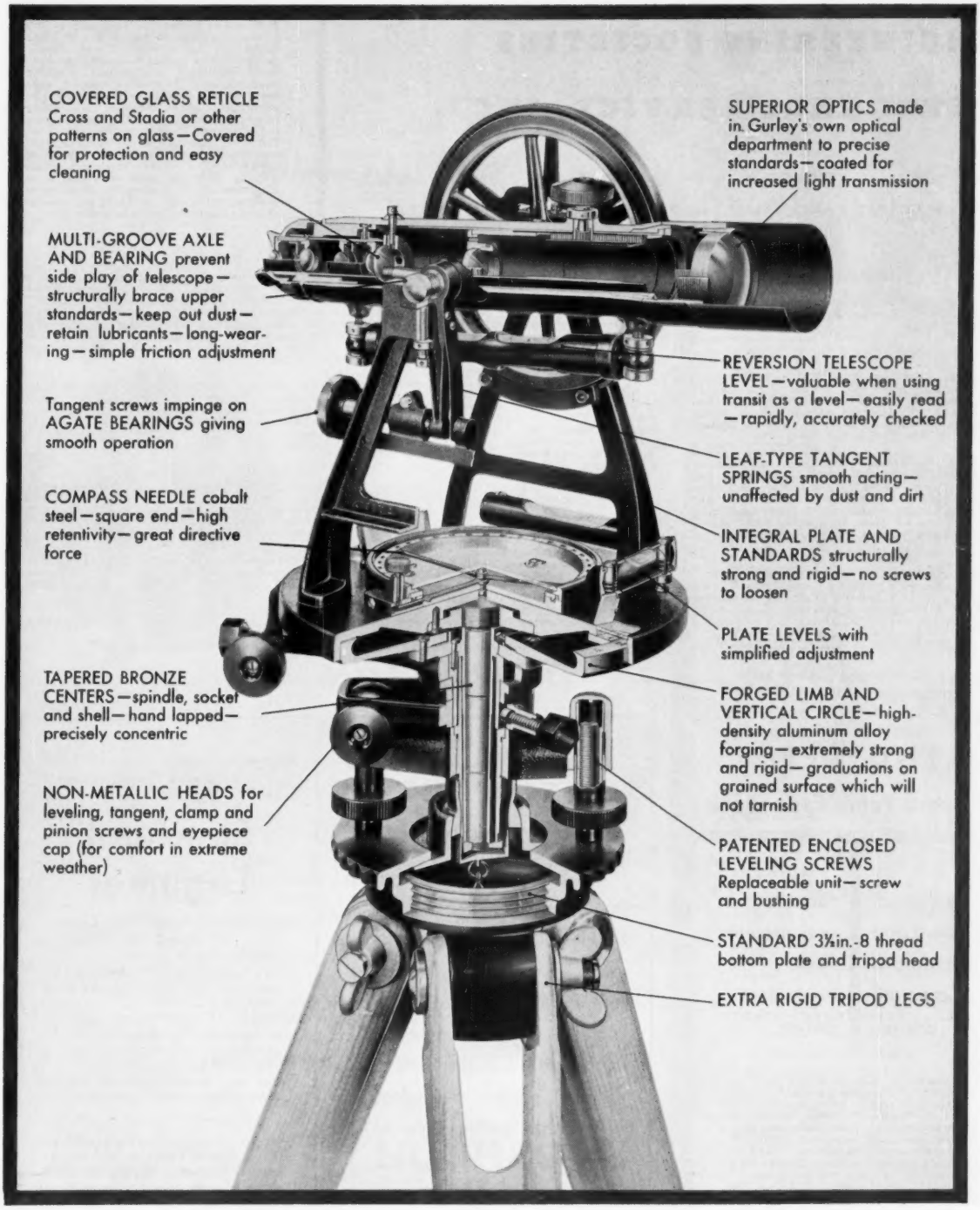
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CIVIL OR MINING ENGINEER, J.M. ASCE; B.S.C.E.; 26; 2 years' hardrock mining, one and one half years' officer in Corps of Engineers, three years' bauxite exploration and processing. Desires responsible position with future in mining, construction, or plant engineering fields. Location desired, western United States or Foreign. C-153.

CIVIL ENGINEER, J.M. ASCE; BSCE; 27; 3 years' experience on heavy construction, 3 years' Navy experience includes 13 months' as resident officer in charge of construction. Location desired, south, southwest or foreign. C-154.

CIVIL ENGINEER, J.M. ASCE; 10 years' experience in structural and sanitary engineering. 4 years' in private practice. B.S.C.E. and M.S. C.E. degrees. Registered P.E. in 5 midwestern states. Dissolution of my partnership makes me available for association or employment. C-155.

CIVIL ENGINEER; M. ASCE; 54; civil graduate; 30 years' private and public practice; registered New York, North Carolina, Virginia, Maryland, Nebraska, Washington, D.C., and Ohio; N.B.E.R. certificate of qualification. Administrative and supervisory experience in diversified fields: turnpikes, airfields, water, sewage and waste treatment, dams; investigations, reports, planning, specifications, estimates, contracts, supervision, and construction materials. Available at once. Prefer south. C-156.

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HYDRAULIC DESIGN ENGINEER, B.S. in engineering, and at least 5 years' experience in machine design; some experience in hydraulic circuits and general application of hydraulics; experience in glass factory desired. Salary open. Location, upstate New York. W-3613(*a*).

SUPERINTENDENT with heavy construction experience for river flood control project. Salary, $10,000 a year. Location, Massachusetts. W-3635.

HIGHWAY AND BRIDGE DESIGNERS AND DRAFTS-

(*Continued on page 132*)

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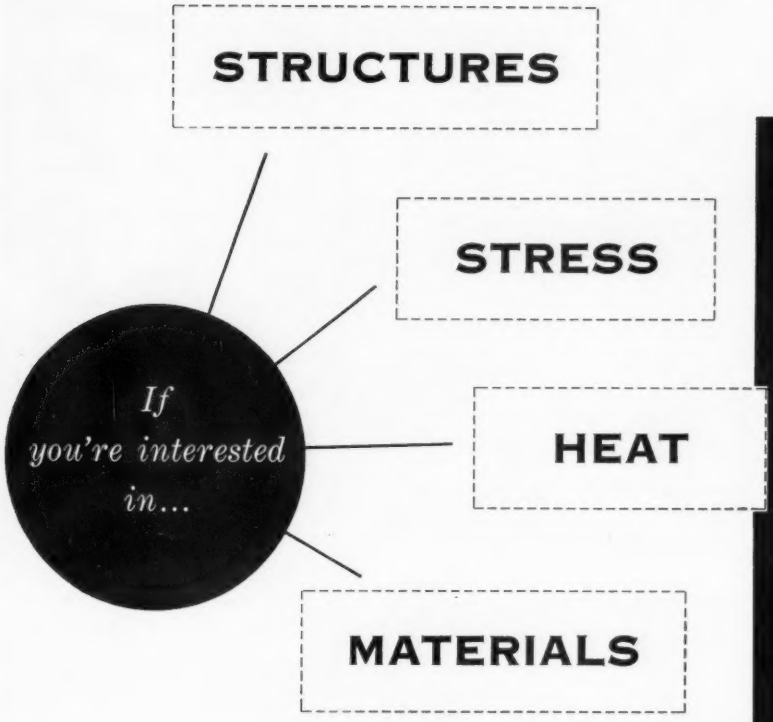

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(Continued from page 130)

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FIELD ENGINEER, young, with civil engineering training, to do surveys. Some experience in contour work, earth moving, landscaping, etc., desired for company which plans and builds golf courses. Salary, $5,200–$6,500 a year. Headquarters, New Jersey; various locations on job for varying lengths of time. W-3664.

TEACHING PERSONNEL for Civil Engineering Department. (*a*) Associate Professor. (*b*) Instructor. Salaries, open dependent upon education and experience. Location, Pennsylvania. W-3675.

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CIVIL ENGINEERS, graduates, experienced in hydraulic and/or earth dam design. Salaries open. Location, Pennsylvania. W-3713.

SANITARY ENGINEER for sales work in industrial and municipal waste disposal field. Should have experience or degree in sanitary engineering. Salary open, based on qualifications. Location, Philadelphia, Pa. W-3722.

HYDRAULIC ENGINEERS. (*a*) Assistant, graduate civil, with one year of experience. Salary, $4,560–$5,460 a year. (*b*) Senior, graduate civil, with 3 years' experience in hydraulics, water supply or flood control engineering. Salary, $5,460–$6,660 a year. (*c*) Principal, graduate civil, with 5 years' experience in hydraulics, water supply or flood control engineering. New Jersey Professional License required. Salary, $6,420–$7,620 a year. Location, New Jersey. W-3737.

SANITARY ENGINEER, either recent graduate civil with sanitary option, or with several years' experience in the design of sewerage systems and treatment plants. Salary, to $6,500 a year. Location, Connecticut. W-3755.

FIELD ENGINEER graduate civil, for field inspection of air force installations, new construction and rehabilitation. Will involve electrical, plumbing and heating as well as general construction. Salary, to $9,000 a year. Location, New York, N.Y. W-3764.

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(Continued on page 134)

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Flush antennas: a creative challenge for Boeing "C.E.'s"

The translucent "window" slightly above and to the right of the man's head is a plastic and glass fiber insulator which electrically isolates the fin tip from the rest of the airplane's structure. This permits the tip to be used as an antenna—one of more than 50 on the Boeing B-52. Many of these antennas take structural loads, and they must function perfectly through extremities of stress, vibration and temperature change. Civil engineers were vital in developing them.

In this and other projects for airplanes and guided missiles, civil engineers investigate new materials and new ways of using them, and devise structures and components to withstand the extreme conditions of high-speed flight. At Boeing, civil engineers also find stimulating assignments in structures and stress analysis, thermo and fluid dynamics, structural and flight testing, and many other fields. Their job is to develop structures that "weigh nothing and take no space."

Flush antennas will become increasingly important as planes and missiles enter the hypersonic region. They are just one example of how, at Boeing, engineers find challenging and creative work, and a chance to be leaders in the growth of the engineering art. Because of Boeing's steady expansion, the number of engineers employed by the firm has actually quadrupled during the past ten years. And more engineers are needed for research, design and production on the B-52, the 707 jet transport, the KC-135 jet tanker, the BOMARC IM-99 pilotless interceptor, and on other projects which cannot yet be announced.

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If you qualify for any of these challenging opportunities, we invite you to contact Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., Hawthorne, California, or call ORegon 8-9111, Extension 1893.

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(*Continued from page 132*)

teriological and microscopical examinations of water; preparation of reports, etc. Salary open. Location, South America. F-3772.

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CIVIL ENGINEERS. (*a*) Engineering Assistant, B.S. in civil, and at least 2 years' experience in field and office work on small structures, highways, topographic surveys, drainage studies, etc. Salary, to $5,200 a year. (*b*) Engineering Drafts man, civil engineering degree preferred but not essential; at least 2 years' experience in field and office work on civil engineering project such as highways, structures, drainage, sewer systems, etc. Salary, to $4,800 a year. Location, Bergen County, New Jersey. W-3784.

ENGINEERS. (*a*) Construction Superintendents, to take complete charge, including supervision over subcontracts, for the construction of alterations and new plants for chemical manufacturer. Salary, to $10,800 a year. (*b*) Estimator to make complete estimates on buildings and equipment in chemical plants. Salary, to $8,400 a year. Location New York, N.Y. W-3792.

CONSTRUCTION BUYER, 25–32, chemical, mechanical or civil engineer, with 4 to 6 years' experience in industry, 2 years' of which should have been in purchasing of construction or plant maintenance materials or allied work in the plant engineering department. Salary, $6,500–$7,300 a year. Location, New Jersey. W-3797(*b*).

CIVIL ENGINEERS. (*a*) Assistant Resident Engineer, civil graduate, ASCE member, with at least 10 years' excavation, foundation, waterproofing and general heavy construction experience. Salary, $10,000 a year. (*b*) Section Engineer, civil graduate, with at least 5 years' field engineering experience in heavy construction and industrial building work. Salary, $6,500–$7,200 a year. Location, eastern Maryland. W-3818.

ASSISTANT CHIEF ESTIMATOR with at least 5 years' experience on take-offs, pricing, costing and sub-contracting covering heavy construction, highways and industrial construction. Salary, $7,800–$9,100 a year. Location, New York, N.Y. W-3827.

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PLANT ENGINEERING-OIL PIPELINES, civil or mechanical, or mining graduate preferably, with several years' experience with oil in pipeline department on maintenance, construction and design of tanks, pipelines, pumping installations, etc. To work under Senior Petroleum Engineer on production and development of oil wells for advance planning. Single status on one year contract, with 30 days' paid vacation and travelling time returning to United States. Salary, $700–$800 a month and living expenses. Location, Foreign. S-2021.

CIVIL ENGINEERS. (*a*) Senior Engineer, civil graduate, with at least 5 years' engineering responsibility covering buildings, roads, airstrips, utilities, POL facilities, transmission towers, shops, etc. Salary, $7,200 a year minimum. (*b*) Assistant Engineer, civil graduate, with at least 2 years' engineering experience on airfield construction and maintenance. Salary, $6,000 a year minimum. Location, New Jersey. W-3853.

CIVIL ENGINEERS. (*a*) Engineers experienced in highway surveys and design. (*b*) Soils Engineer with field and laboratory experience in soils mechanics. (*c*) Structural Designers and Detailers. Salaries open. Position permanent. Location, eastern U.S. W-3854.

SUPERINTENDENT for construction and maintenance department, registered engineer with considerable United States construction experience, capable of supervising all major construction, repairs and maintenance of housing and commercial structures. Salary, $12,000 a year. Location, Chile. F-3855.

SURVEYOR, young, for quantity surveying, both in field and office, establishing location and elevation for sewers, water lines, water drainage and building site excavation. Salary, $5,200–$6,500 a year. Location, northern New York State. W-3856.

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(*Continued from page 116*)

BERNARD CONTRERAS SOTO, San Jose, Costa Rica.
THOMAS LOWE STARNES, JR., Flagler Beach, Fla.
RUSSELL DWIGHT TAYLOR, Phoenix, Ariz.
SERGIO LUIS TELLO, New York, N.Y.
SYLVIO TUCCILLO, Brunswick, Me.
WILLIAM CLARENCE TURNBULL, Middletown, Ohio.
JOHN WAGNER WEBER, Chicago, Ill.
WILLIAM DAVID WOODS, Columbus, Ohio.
MICHAEL YACHNIS, Washington, D.C.

Applying for Junior Member

RICHARD J. BELL, Reading, Pa.
GASTON PAUL BERTHELOT, JR., Houston, Tex.
WALTER EDWARD CAPPER, New York, N. Y.
ADRIAN RAMON CHAMBERLAIN, Fort Collins, Colo.
RAFAEL BENITEZ COUBERTIER New York, N. Y.
HOMER GARDNER CROWELL, Rolla, Mo.
ROBERT DEWAYNE FENNER, Baton Rouge, La.
HARALD DIXEN FREDERIKSEN, Excelsior, Minn.
RICHARD JOHN HARGRAVES, Norwalk, Calif.
WILLIAM EDWARD HINTON, Birmingham, Ala.
ROBERT DONALD QUIJADA, Gardena, Calif.
HUGO ALFONSO RIOS, Montreal, Que., Canada.
DONAL HENDRIK TIMMER, New Cumberland, Pa.

[*Applications for Junior Memberships from ASCE Student Chapters are not listed*]

Advance Information on Attendance at ASCE Annual Convention

This is not an advance ticket order. Do not send payment. No name needed.

To: Mr. John E. Heinzerling
Chairman, Registration & Information Committee

% Richardson, Gordon & Assoc.
3 Gateway Center
Pittsburgh 22, Pa.

I plan to attend the annual Convention and I shall bring.....guests. During the Convention I plan to attend the following events, tickets for which I shall purchase when I register:

FUNCTION	NO. OF TICKETS
Monday, Oct. 15	
Sanitary Engineering Luncheon	
Kickoff Party	
Ladies' Luncheon	
Tuesday, Oct. 16	
Construction Division Luncheon	
Ladies' Luncheon	
Power Division Trip	
Wednesday, Oct. 17	
Annual Membership Luncheon	
Annual Dinner-Dance	
Thursday, Oct. 18	
Highway Division Luncheon	
Student Activities Luncheon	
Structural Division Trip	
Construction Division Trip	
Pipeline Committee Trip	
Ladies' Boat Trip	
Smoker	
Friday, Oct. 19	
Highway Division Trip	
Waterways and Harbors Division Boat Trip	

Here are important facts for the "man behind the gun"

This White 18" Dumpy level has ...more of the features you want, yet costs you less!

Before you buy, compare this White Dumpy level with a similar model of any other recognized make. From every standpoint — design detail . . . quality construction . . . work-speeding, life-lengthening features and cost — you'll quickly see why a White's the best buy you can make. It will make your work faster, easier, more accurate. Check this comparison chart:

FEATURES	D. White No. 7080	Instrument A	Instrument B
Magnifying power of telescope	35X	30X	27X
Distance away you can read 1/100 ft. graduation	1200 ft.	1050 ft.	900 ft.
Diameter of objective lens	1.81 in.	1.485 in.	1.69 in.
Field of view (in minutes of arc)	64'	52'	60'
Coated optics	YES	YES	YES
Covered leveling screws	YES	YES	YES
Can you easily replace worn leveling screws in the field?	YES	NO	YES
Sensitivity of level vial (in seconds of arc per 2mm of graduation)	20"	20"	25"
Price — complete with carrying case, tripod and accessories — F.O.B. factory	$315.00*	higher	higher

For complete details on the 18-in. Dumpy level and other equally fine engineering instruments, see your David White dealer, or write direct to DAVID WHITE CO., 309 W. Court Street, Milwaukee 12, Wisconsin.

DAVID WHITE COMPANY

We offer complete, expert repair service on all makes, all types of instruments.

**Price subject to change without notice.*

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Crash Pusher

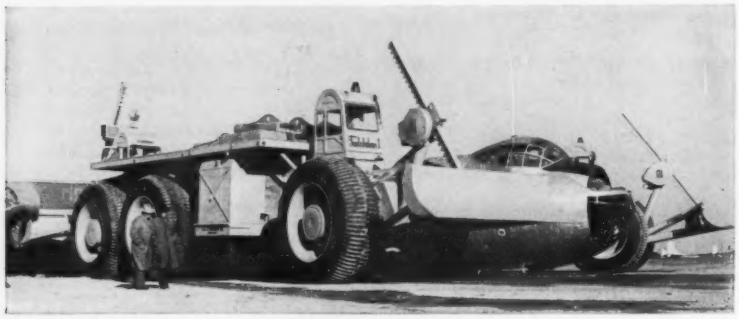
THE WORLD'S LARGEST AND MOST powerful bulldozer type machine, designed for moving crashed bombers from runways, has been delivered to the U. S. Air Force.

So powerful is the mammoth mover that a single pair of them can completely remove a 400,000-lb crashed bomber in less than 20-min. The same task, using conventional equipment, formerly required from 5 to 15 hours Primarily, the bungalow size vehicles are designed for use during emergency operations when an aircraft has crashed and keeping other planes from taking off or landing. They are built around the same functional components, and use the same fundamentals of design, as all other mobile equipment built by LeTourneau, Inc.

A powerful, high torque electric motor is geared directly to each individual wheel making each one an independent drive unit. However they are designed to work together as a team. If one or more of the wheels lose traction, their portion of the machine's total horsepower is automatically transferred to other wheels which are taking hold.

Another feature built into this and other equipment is a highly effective regenerative braking system which furnishes operational braking without wearing parts. Mechanical brakes also are included on the machine for parking and emergency conditions.

In size, the machine is more than 67-ft long, more than 17-ft high, and more than 13-ft wide. It travels on six of the largest tires in the world, each being 10-ft high and 4-ft wide, and each with a ground contact area of 1,500 sq in. **R. G. LeTourneau, Inc., CE 9-136, 2399 South MacArthur, Longview, Texas.**



Mammoth 151,000 lb Mover

Coupler

ESPECIALLY DESIGNED FOR ALL types of portable aluminum petroleum pipe, the new FMC Fast Move coupler is now being manufactured. For the first time, you can run portable aluminum lines with any brand of pipe and at any pressure the pipe will handle.

The FMC coupler has a quick, positive lock. It is not treaded, but locks like the breach of a powerful naval gun. A quick one-quarter turn locks or unlocks the coupler. No time is lost turning long threads. Simple spanner type wrenches work easily. There are no threads to be damaged while bouncing in a moving truck. The husky locking jaws of the coupler are not susceptible to damage. It has no loose parts to be lost, jammed, clogged, or damaged and is extremely simple, being composed of only three parts; a male union, a female union and a fitted gasket.

The gasket gives a positive seal against the ends of the pipe and becomes immediately leakproof at all pressures. Because of its unique design, the higher the pressure, the tighter the gasket is sealed. It is set flush with the inside periphery of the pipe, thus eliminating turbulence. The coupler gasket is made of a special purpose blend of Buna N stocks. Oil men know this means long service because this material is highly resistant to the action of brines, crude oil, butane, natural gas, etc.

The coupler is made of a superior corrosion resistant aluminum alloy, heat treated to give maximum strength and durability, designed compactly with a symmetrical and smooth exterior for freedom in handling, stacking, and transporting. **John Bean Division, Food Machinery and Chemical Corp., CE 9-136, San Jose, Calif.**

New Plastic Expansion Joint Waterstop

PLASTI-GRIP, A 3 IN 1 JOINT, made of extruded plastic, Poly-vinyl-chloride, that can be used as an expansion joint, a construction joint or as a waterstop, has just been introduced. It comes in continuous strips 100-ft long and 5-in. or 6-in. wide and can be cut with a knife and spliced on the job with a hot iron in minutes. Its deep grooves grip far better into the concrete than flat or dumbbell type joints and its exclusive reinforced "U" center pleat expands and contracts with the joint. It is designed to give the most effective joint between two pours of concrete. Resisting water pressures up to 125-ft head, it stays flexible even in extreme low temperatures, is alkali and acid resistant, and has virtually unlimited life. **Progress Unlimited Inc., CE 9-136, 15 West 44th St., New York 36, N. Y.**

New John Deere Crawler

THIS POPULAR NEW CRAWLER offers a new power and stability mounted with a Shawnee Loadmaster front end loader and a Scout D70HL Backhoe.

The Loadmaster has large twin bucket cylinders and the entire loader is mounted on the tool bars of the tractor. The 60-in. material bucket can be replaced by other attachments including a bulldozer blade and a 72-in. manure fork. It has a lifting capacity of over 3,500 lb to a 9-ft dumping height.

The Scout Model D70HL Backhoe has individually powered leveling "feet" and double acting hydraulic cylinders with chrome plated rods throughout. It operates on an exclusive patented drag line principle which provides additional digging power. The model digs to 12-ft deep, reaches 14-ft and loads to a 9-ft dumping height.

Shawnee Loader and Backhoe

Both units operate from a 15-gpm Hyreco crankshaft driven pump with the oil reservoir in the frame of the loader. The six bank free flowing valve system enables the operator to use two or more controls at the same time. **Shawnee Manufacturing Co., CE 9-136, Topeka, Kansas.**

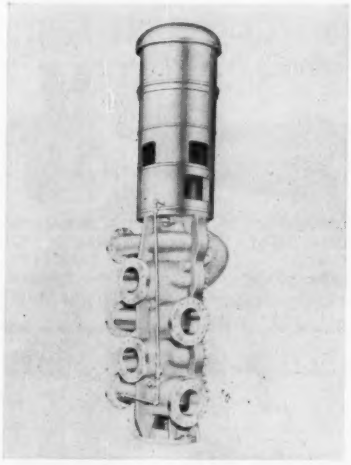
EQUIPMENT MATERIALS and METHODS

(continued)

Features Four Pumps

A NEW VERTICAL MULTI-UNIT condensate pump features four pumps in a common case and utilizes a common shaft. It has been aptly nicknamed the "Sow Pig" because of eight flanges—four intake and four discharge. This four-pumps-in-one design was developed to save valuable floor space in powerplants; realize economies of a common driver; and increase reliability because the use of four pumps on a common shaft requires only a single stuffingbox—reducing packing maintenance.

Three of the four pumps in each unit are single stage pumps, and the fourth is a two stage pump with an external crossover. The unit is driven by a vertical electric motor, and axial and radial



New Multi-Unit Condensate Pump

hydraulic balance is obtained by using double suction impellers and double voluted pump cases.

The outer casing is the vertically split type with the four sets of inlet and outlet nozzles located in one half to allow the removal of the rotating element without disturbing the suction of discharge piping.

This new style condensate pump, specially engineered to meet a customer's particular requirements, has been in successful use for more than a year. Six new 715 hp units are also now on order for one of the South's major municipal power departments. **Byron Jackson Pumps, Inc., CE 9-137, P. O. Box 2017A, Terminal Annex, Los Angeles 54, California.**

In 11 days, bedrock depth for Berkshire Thruway was measured at 220 points

The Berkshire Thruway is a key 30-mile arterial link connecting the New York State Thruway near Selkirk, N. Y., with the Massachusetts Turnpike near Stateline, Mass. The design engineers for one of its sections needed to know bedrock elevations and general overburden conditions at sites of important cuts and highway structures. To expedite obtaining this information the seismic method was adopted for preliminary investigations. A Gahagan 4-man Seismic Survey Crew did the work, using portable equipment. Their subsurface exploration, with bedrock found at depths exceeding 90 feet in some cases, covered 220 points. It was completed in 11 days between Nov. 14 and 30, 1955, and provided the required data. For a factual report on how seismic surveys save time and money, provide a wealth of extra information, write on your letterhead for Bulletin 2 to Geophysical Survey Division, Gahagan Dredging Corporation, 90 Broad St., New York 4, N. Y.

Established in 1898, Gahagan is a leader in hydraulic dredging

ANOTHER
GAHAGAN
CASE HISTORY

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SURVEYING NEWS

NEW THEODOLITE SETS UP QUICKLY, EVEN IN THE WIND

Has this been your problem? Now—old-type mechanical plumb-bob replaced by can't-miss optical principle

- **Improved Theodolite reads horizontal and vertical circles simultaneously, through same eyepiece**
- **Reads direct to 1 min. with no matching of lines—no parallax**
- **Amazingly blur-free—small, compact, moisture-proof, dust-proof.**

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45-22 Pearson St., Long Island City, N.Y.

Please send me Booklet D with information on Fennel . . .

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- ☐ Stands
- ☐ Combinations
- ☐ Tripods
- ☐ Theodolites
- ☐ Repair of present instruments, (any make)

NAME.....

ADDRESS.....

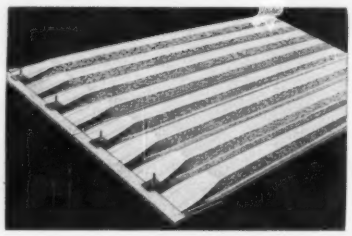
.....

EQUIPMENT MATERIALS and METHODS

(continued)

Fabricated Steel Form

A "LEAVE-IN-PLACE" STEEL FORM for concrete bridge flooring has been developed, designed especially for spans involving high or hazardous conditions. These forms can be adapted for almost all poured concrete floors. Fabricated from trapezoidally corrugated long life galvanized steel sheets in laying widths approximating 24-in., they reportedly can be economically left in place. This novel feature eliminates the necessity for wood form construction, shoring, safety nets, and stripping operations. Bridge erection schedules are said to be speeded up, fewer manhours are required, and waste of valuable form lumber is eliminated. The forms are custom made at the plant to fit the bridge structurals and shipped to the site ready for immediate installation by a small crew. No equipment other than common hand tools is necessary. In addition, finish coats of structural painting and other operations can be simplified by performing these from top-side before the concrete flooring is laid. **United Steel Fabricators, Inc., CE 9-138, Wooster, Ohio.**



"Leave-in-Place"

Stud Driver

A NEW LOW COST POWDER ACTUATED stud driver, the Mighty-Mite Model 456, designed specifically for small home builders and installation contractors, has been placed on the market. Biggest advantage of this tool is its low initial cost and easy adaptability to jobs calling for low volume fastening output. It serves the need for an inexpensive, quick method to fasten wood to metal, or wood and metal to concrete and many builders, contractors, and maintenance people have found this stud driver very satisfactory.

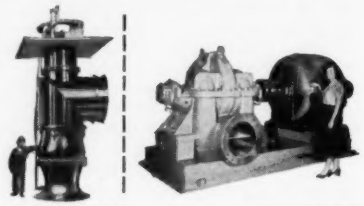
The Mighty-Mite is constructed of three simple parts and weighs only $3^3/_4$-lb. After a stud with power guide disc attached has been placed in the barrel, the operator inserts a 22 caliber power load. When he twists and depresses the tool against the work surface, the firing pin is

(Continued on page 140)

YOU NAME THE PURPOSE WE MAKE THE PUMP

For every specific need from the smallest to the giants of 200,000 GPM capacity — Highly specialized engineering and manufacturing for over 40 years assures freedom from maintenance worries — Many users report 15 to 20 years service without replacement of major parts.

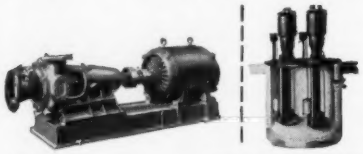
WHEELER-ECONOMY PUMPS



VERTICAL AXIAL FLOW FOR CIRCULATING CONDENSER COOLING WATER

DUAL VOLUTE FOR MUNICIPAL WATER WORKS

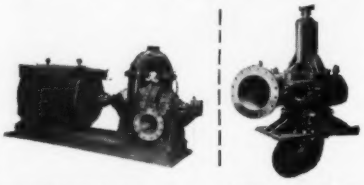
WHEELER-ECONOMY PUMPS



HORIZONTAL NON-CLOG FOR SEWAGE, TRASH, STOCK

DUPLEX, SUBMERGED NON-CLOG FOR SANITATION SEWAGE, INDUSTRIAL WASTE

WHEELER-ECONOMY PUMPS



TWO-STAGE DMD HIGH HEAD FOR MUNICIPAL & INDUSTRIAL SERVICE

VERTICAL MIXED FLOW FOR IRRIGATION, DRAINAGE, FLOOD CONTROL, SEWAGE

WE-500

ECONOMY-PUMPS, INC.

Division of

C. H. WHEELER MANUFACTURING CO.

ECONOMY PUMPS, INC. • DIVISION OF C. H. WHEELER MANUFACTURING CO. 19TH AND LEHIGH, PHILADELPHIA 32, PA.

Save

with

Permanent

Copperweld*

TRADE MARK

MARKERS

- PROTECT your investment in the original survey—and protect yourself from troublesome disputes.
- AT LITTLE COST you can quickly and easily drive Copperweld* Markers and have permanent reference points. Bronze head can be center-punched and stamped for identification. If larger head is needed, a 4″ adapter is available.

*Trade Mark

Standard length is 3 feet—other sizes can be furnished. Packed 10 markers to a carton.

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION Glassport, Pa.

Write for Bulletin 144

Annual Convention of ASCE

Penn-Sheraton Hotel, Pittsburgh, Pa., Oct. 15–19, 1956

HOTEL RATE INFORMATION

Accommodation	Penn-Sheraton William Penn Pl. Pittsburgh 19, Pa. (Convention Hotel)	Carlton House 550 Grant St. Pittsburgh 19	Pittsburgher Hotel 428 Diamond St. Pittsburgh 19
Single w/bath	$ 7.50–$10.50	$11.00–$16.00	$6.50–$ 9.00
Double w/bath	$10.50–$13.50	$14.00–$18.00	$8.00–$10.00
Double-twin beds w/bath	$13.00–$19.00		$11.50

(Clip coupon blank for mailing)

(Please print)

Name .....

Street .....

City ..... Zone ..... State .....

Mail to: ASCE Convention Reservations

..... Pittsburgh, Pa.
(Hotel of choice)

Single ..... Double .....

Double-Twin Beds ..... Suite .....

Other .....

Date and hour of arrival .....

Date of departure .....

High Early Strength

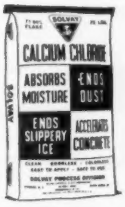
Cold Weather Safety

Higher Ultimate Strength

Get All 3 By Adding Solvay Calcium Chloride To Cold Weather Concrete

You can offset the strength and time losses resulting from temperatures of 50° F. or lower *and gain in ultimate strength* by adding Solvay Calcium Chloride to your concrete mix.

Speed finishing, remove forms earlier, save 2–4 days operating time. Get all the facts and figures in the booklet entitled, "The Effects of Calcium Chloride on Portland Cement."



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Easy to Handle

Provides Accurate Measure

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GET THE COMPLETE STORY
GET FREE BOOKLETS NOW
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ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

Please send me WITHOUT OBLIGATION OR COST your booklet:

☐ "When the temperature drops BELOW 50°F., do you know what happens to CONCRETE?"

☐ "The Effects of Calcium Chloride on Portland Cement."

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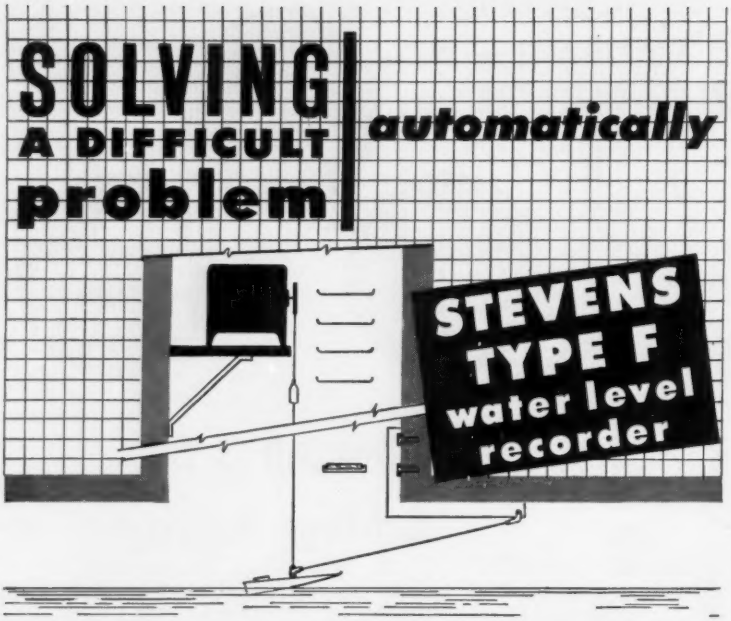
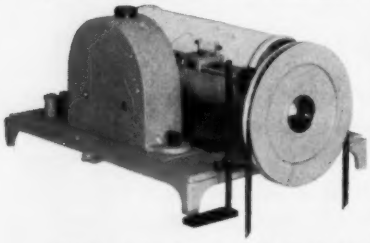
CITY ..... ZONE ..... STATE CI-9



PROBLEM: To obtain automatic, graphic records of the flow of sewage in a sewer main without the expense of installing a weir and float well.

SOLUTION: Install a STEVENS Type F Water Level Recorder mounted on a bracket in a manhole. Use a scow float to operate the recorder and make a stage-discharge rating of the flow. Or, following construction details and rating tables we provide, also install a STEVENS critical flow control down stream to establish a positive depth-flow relationship.



The planning and efficient operation of any project which involves measurement of flowing liquids is based on flow data which can be obtained with STEVENS water level recorders. STEVENS instruments are at work compiling data on hydroelectric and flood control projects, and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

STEVENS DATA BOOK

...invaluable for your reference file

144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables.

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LEUPOLD & STEVENS INSTRUMENTS, INC.

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Foremost in Precision Hydraulic Instruments Since 1907

EQUIPMENT MATERIALS and METHODS

(continued)

exposed at the top. A light, sharp hammer blow against the pin fires the tool. The 22 caliber power load sends the nail-like stud into the work surface to complete the fastening. An operator can drive studs at a better than one per minute rate.

The power loads are manufactured in a number of different strength powder charges to permit the operator a wide range of selection for varying job requirements. A new type steel washer disc assures correct penetration with no splitting of work surface, and a number of different alloy steel studs, headed, externally threaded, internally threaded, and other types, are available. **Remington Arms Co., Inc., CE 9-138, 140, Public Relations Division, Bridgeport, Conn.**

New 17-Ton Hydraulic Jack

An advanced concept of hydraulics applied to Air Force needs for lifting heavy planes resulted in the development of a powerful 17-ton hydraulic jack that not only is most efficient, but is extremely compact and light in weight.

Ideal for heavy lifting in the aircraft field, its unusual features make it suitable for buses, trucks, trailers, road machinery, farm implements, construction, and in-plant use.

Lifts Heavy Loads Easily

This new type of power-pack for lifting or pushing large masses is so small that it can be carried in the trunk of a car, or mounted on a wheel plate. From a base of nine in., low enough to get under most large units that must be lifted or moved, the telescopic cylinder raises to an extended height of twenty-nine in. The heaviest loads can be lifted with a minimum of effort by extending the handle, and it can be pumped either fast, medium, or slow. One man can easily lift a huge fire engine, truckload of steel, or a giant airliner.

A special safety device features a built-in relief valve which prevents overloading, and it can be set to any predetermined pressure. **Los Angeles Automotive Works CE 9-140, 1020 Towne Avenue, Los Angeles, California.**

EQUIPMENT MATERIALS and METHODS

(continued)

Portable Compacting Screed Finisher

KNOWN AS MODEL 5-S, a new portable compacting screed finisher, suitable for use on 20 to 32-ft wide slabs, is announced. This new machine is reputed to provide increased pavement production and lower operating costs because its two 16-in. wide screeds can produce a smooth, finished surface in one pass, at rates up to 18-fpm.

A range of six travel speeds and twenty four screed speed combinations allows selection of the finishing rate best suited to individual paving job requirements, the manufacturer states. Instant reversing, full hydraulic control of front and rear screeds, plus easy interchangeability of track wheels and positive drive on all four wheels also contribute to the machine's operating efficiency.

Model 5-S

Readily adaptable to a variety of paving operations, Model 5-S is fully adjustable for widths from 10 to 15, 12 to 18½, 20 to 26 and 20 to 32-ft. Special width sizes are available. Frame width changes can be made quickly, without adding or removing parts. A built in ratchet and bar speeds width adjustment. Provision also can be made for hydraulic self widening of machine frames. Each screed is fitted with a double row of crown bolts for precise contouring of the screeds to roadway crown specifications.

An integral transportation rig, consisting of two retractable pneumatic tired truck type wheels and a hinged towing tongue permits fast movement of the finisher between job locations. Wheels are raised and lowered hydraulically. A hydraulic pedestal at the front end is provided for easy alignment of the towing tongue with standard truck hitches and transportation wheels are self locking in both raised and lowered positions. Machine components are said to be designed for maximum trouble free service life. Ball and roller bearings are used throughout the power train, all clutches are heat treated alloy steel, and an automotive type transmission is used. Power is supplied by a 32-hp, 4 cylinder, air-cooled gasoline engine. **General Road Machines, Inc., CE 9-141, Niles, Ohio.**

SONOVOIDS® serve as carriers for utility mains!

Lake Cook Road Bridge, Edens Expressway, Cook Co., Ill. M. J. Boyle & Co., Chicago, contractors. Precasting by Midwest Prestressed Concrete Co., Springfield, Ill.

SONOVOID®

FIBRE TUBES
for voids in concrete construction

A feature in the design and construction of this bridge was the requirement that it also carry two 10 inch gas mains across the stream. Low cost SONOVOIDS solved the problem. In casting the two outside beams three 13'10" SONOVOIDS were used. Placed in the end sections and at the diaphragms of the beams, they created a hollow throughout the length of the beams providing the carrier for the gas mains.

The ten precast beams used to form the bridge deck, were 26" x 33" x 41'6" and three 24.5" O.D. SONOVOIDS were used in each beam. Placement of the beams was done with a crane.

Although SONOVOIDS have been specifically developed to form voids in bridge deck and piles and wall, floor and roof slabs, the use of the fibre tubes in such units as carriers for utility services is practical and economical.

SONOVOIDS are for use in prestressed and poststressed precast concrete units and units cast in place.

Sizes from 2.25" to 36.9" O.D. up to 50' long. Can be supplied in specified lengths or sawed to your requirements on the job. End closures available. Order SONOVOIDS for your next job!

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Waterstop *in place in seconds!*

LABYRINTH WATERSTOP after first pour has been made and form removed. The grooves receive the concrete from the second pour, providing an interlocking joint.

Just a few seconds were needed to nail this LABYRINTH WATERSTOP to the form... just a few seconds and water seepage worries were over before they could ever have a chance to start. LABYRINTH WATERSTOP forms a waterproof bond between two pours. The corrugated ribs bond firmly with the concrete.

LABYRINTH WATERSTOPS are made of flexible polyvinyl plastic... that has superior weathering qualities, is not affected by temperature changes and chemical activity.

LABYRINTH WATERSTOPS are easy to work with, can be cut to any desired length. "L" and "T" joints can be welded with just a hot knife. Find out now how your costs can be cut... and end your seepage problems. Just mail the coupon to:

WATER SEALS, *inc.*
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EQUIPMENT MATERIALS and METHODS

(continued)

Back Rippers

NEW OVERSIZE BACK RIPPERS for Caterpillar D9 Tractors have been introduced and are also available for Caterpillar No. 9S straight blade bulldozers. These are comprised of four housings with pivoted shanks capped with lock on teeth and are welded to the reverse side of the straight blade moldboard.

The outer back rippers dig into the ground approximately 18-in. as the tractor backs up. The inner shanks rip to a 12-in. depth. On the forward trip they skid on top of the ground. Where desired, one or more of the shanks can be pinned up out of the way. The outer shanks can be raised to a 12-in. ripping depth, also.

For Caterpillar Tractors

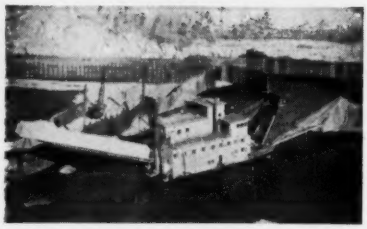
According to the manufacturer, the new back rippers speed up all dozing operations. They break out the hard ground and rocks when the tractor is normally deadheading on the back-up trip, thus conditioning the earth for the blade to make a full load faster on its forward pass. Many are in use on tractors around the world for all types of dozing jobs. They also have proved effective when mounted on pusher tractors for speeding up scraper loading. **Preco Incorporated, CE 9-142, 6300 E. Slauson Ave., Los Angeles 22, Calif.**

Runway Marker Lights

JUST INTRODUCED, THE TYPE HRC runway marker light is equipped with a double prosmatic lens system, which houses a 500-w, 115-v prefocus type lamp. The lamp is attached to a movable support that is driven by means of a thermal spring actuated mechanism. Whenever the current passing through this mechan-

(Continued on page 143)

YUBA



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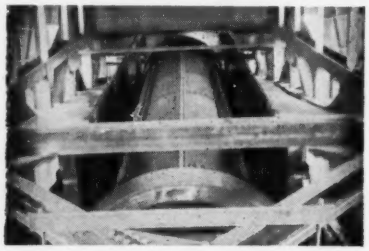

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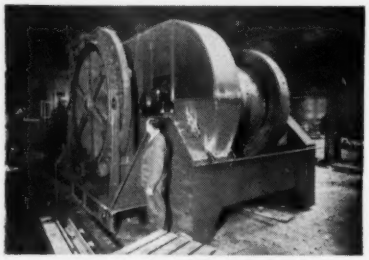

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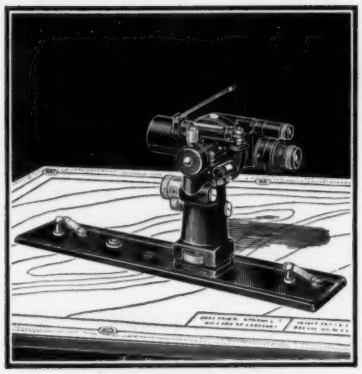

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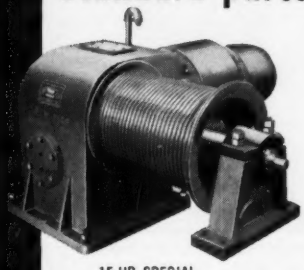

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EQUIPMENT MATERIALS and METHODS

(continued)

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Cable Dump Trailer

Extra inches in height and an improved tailgate latch are the key improvements on this year's single axle Hobbs Schonrock Cable Dump trailer. Minor as they may seem, they make possible a new role for the already versatile standard cable dump—that of hauling maximum loads and working well in conjunction with Barber-Greene and other types of paving finishers in the rapidly increasing construction of asphaltic concrete highways over the nation.

Single Axle Hobbs Schonrock

The new model's frame is of stronger construction at strategic stress points than that of previous units. The trailer's dump body which has up to twice the capacity of the average dump truck, is built higher than older models and more closely fits a spreading machine's hopper during the dump cycle. Extended rear section skirts to channel the mix from the dump trailer into the hopper may be added with much less trouble, either at the factory or at a service branch.

The extra clearance gained by raising the dump body also permits the use of larger tires on the unit, paving the way for greater payloads, better tire mileage and less driver fatigue.

The new latching mechanism, which gains holding power as load and the pull of gravity are increased on it, is an over the top affair at the lower corners of the tailgate. Its simplicity of operation makes it highly resistant to wear. **Hobbs Trailers, CE 9-143, Fort Worth, Texas.**

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Literature Available

VERTISEAL—A descriptive brochure covering this new product is being offered. It is a newly developed rubber type cold applied self-vulcanizing joint sealing and caulking compound which can be applied to both exposed vertical and horizontal joints, available in black and white. **Servicised Products Corp., CE 9-144, 6051 West 65th St., Chicago 38, Ill.**

METAL FURNITURE—A booklet, well illustrated in color, introduces the new Draft-a-Matic, a scientifically designed mechanized drafting desk. Also available, is a detailed booklet on metal furniture for offices, including metal files and shelving and specially designed equipment. **The General Fireproofing Co., CE 9-144, Youngstown, Ohio.**

COMBINATION UNIT—A new, twelve-page, two-color bulletin, "The Dorreo Clariflocculator" is now available. It describes the physical characteristics, principle of operation, types, sizes and advantages of this combination flocculation and clarification mechanism. Also included are photographs of operating installations and line and wash drawings of standard units. **Dorr-Oliver Incorporated CE 9-144, Stamford, Conn.**

GROUTING SPECIFICATIONS—Copies of specifications for the non-shrink grouting of heavy equipment, anchor bolts, building columns, and bridge seats with premixed grout are now available. Giving detailed data, these specifications are arranged in eight sections, with recommendations on: Grouting Materials; Storage of Material; Mixes in Relation to Clearance; etc. Also available is a Functional Specification for pre-mixed, non-shrink grout. **The Master Builders Company, CE 9-144, 7016 Euclid Avenue, Cleveland 3, Ohio.**

SCRAPER—Catalogs, No. 505, 506 and 507, describing the overhung engine line of Euclid scrapers, Models S-7, S-12 and S-18 have just been published. Each of these contain 8 pages of cut-a-way views of major components and photographs that help to explain the accessibility and operating features. Condensed specifications are included to provide data on engines, transmissions, tires, scraper controls, weights and dimensions, also a performance table showing speeds and grade ability. Illustrations and action views show how hydraulic lever action of apron, bowl and ejector provides fast, independent control of all scraper operations. Except for one short length of cable on the apron lift, there are no sheaves, pulleys or cables. Catalog No. 505 covers the S-7 scraper, No. 506 describes the Model S-12 while No. 507 features the S-18 scraper. **Euclid Division General Motors Corp., CE 9-144, Cleveland 17, Ohio.**

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"ALWAYS ON THE JOB"—A 20-min, sound slide film covering the basic principles of safety in electric arc welding has just been produced. A companion film to the prize winning oxyacetylene safety slide film, "The Guy Behind Your Back," the new arc welding safety film also features the light, cartoon approach to this serious topic. Record is 33 1/3-rpm speed. Available on a free loan basis or may be purchased for $15. **Air Reduction Sales Company, CE 9-145, 150 East 42nd St., New York 17, N. Y.**

"STRINGIN' ALONG WITH PENGO"—A new nine minute 16mm color sound movie showing controlled tension stringing of overhead power lines is available to the utilities industry. It shows in detail the Bechtel Corp. stringing 1,033,500 CM grease-impregnated ACSR on a twin circuit tower line, the most important feature of which is the use of the Pengo tension wire stringers. The line was constructed for the Southern California Edison Co. in the City of Los Angeles. **Petersen Engineering Co., Inc., CE 9-145, Santa Clara, Calif.**

"THE DALLES DAM CONSTRUCTION"—Showing progressive construction of the Corps of Engineers' newest unit in the comprehensive plan for development of the Columbia River, The Dalles Dam, 88 miles east of Portland, Oregon, a new 28 1/2-min sound color motion picture, is now available. The film traces construction of this huge multiple-purpose project from its inception until almost the present time. **Division Engineer, North Pacific Division, Corps of Engineers, CE 9-145, 210 Custom House, Portland 9, Oregon.**

"THE SUSPENSION BRIDGE"—one of the four informative 16mm sound motion pictures now available. This is a colorful film on the erection of the Delaware Memorial and Paseo River bridges. "Building for the Nations," also in color, is on the erection of the United Nations Secretariat Building. A technicolor film on the making of wire rope, how it is engineered, and how it is used has been prepared in the form of a story, "Speaking of Wire Rope." Also, very interesting, is the film, "The Waiting Harvest," photographed in Eastman color, which is especially informative on the production of basic chemicals and their conversion to modern miracle products. **Pittsburgh Film Distribution Center, U. S. Steel Advertising Division, CE 9-145, 525 William Penn Place, Pittsburgh 30, Pa.**

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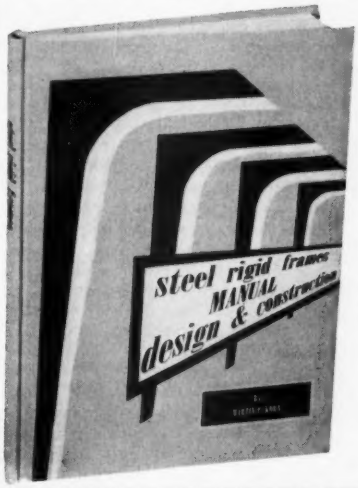

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DESIGNS SPECIAL VALVE: John Kilmer, Chief Engineer of Goldman-Anderson Valve Specialty Co., Pittsburgh, Pa., has designed special automatic valves for use in the new 1500 mile missile installation at Patrick Air Force Base, Fla. . . . **FACTORIES IN FOREIGN FIELDS:** Hyster Co. has announced plans to open new manufacturing plants in São Paulo, Brazil and Glasgow, Scotland. These will supplement production of the plant now established in Nijmegen, The Netherlands . . . **ALUMINUM IN COLOR:** The Aluminum Co. of America has announced that its entire line of industrial building products now is available in a new "Architectural Alodine," a soft green finish . . . **CRANE CARRIER:** a $5,936,939 order for another crane carrier to be built by Four Wheel Drive Auto Co. for the Corps of Engineers was announced. This company has built more than 1800 carriers for the Department of the Army in recent years . . . **STEEL SPHERE FOR ATOMIC REACTOR:** The Chicago Bridge & Iron Co., has been awarded a contract for construction of a 190 feet in diameter steel sphere that will house the atomic reactor being built by the General Electric Company for the Dresden nuclear power station near Chicago . . . **PRESTRESSED CONCRETE CASTING BED:** A 430 feet Form-Crete, all steel, Double T prestressed concrete casting bed now installed at the R. H. Wright yard, Ft. Lauderdale, Fla., is the longest continuous installation in the southeast and one of the few of that length in the country. The forms were manufactured and shipped in 30 feet lengths by the Florida Div. of Food Machinery & Chemical Corp., Lakeland, Fla. . . . **TWO DAY OPEN HOUSE:** featuring continuous demonstrations of new construction equipment, the grand opening of Garlinghouse, Fremon & Company's sales headquarters and service center, took place on July 13–14. Factory representatives, including the American Tractor Co. and Unit Shovel & Crane Co. were on hand to demonstrate this machinery . . . **AUTOMATIC RECORDER:** believed to be unique to Charlotte, N. C., their Water Department has two specially designed trailers equipped with automatic recorders to make 24 hour tests of plant effluents. A new pH recorder by Leeds & Northrup, Philadelphia, Pa., is included with this equipment . . . **ELECTIONS:** Earl F. Harris has been elected President of the Rodney Hunt Machine Co., Orange, Mass. . . . **APPOINTMENTS:** J. Arthur Fitzenz has been appointed Manager in charge of Domestic Sales for Austin-Western Works, Aurora, Ill. . . . Intrusion-Prepakt, Inc. has named Richard D. Murphy as Manager of its New England District office, at Boston, Mass. . . . John McManus has been appointed direct factory salesman for Lancaster Pump & Mfg. Co., to serve the distributors in Tenn., Ky., W. Va. and Va.

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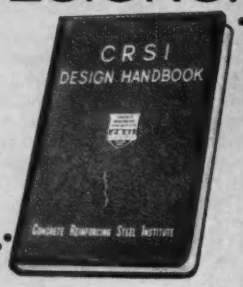

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For instructions and Key to Abbreviations, see next page. Each member is entitled to 100 free "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. To register, mail the enrollment form on page 149 to Society Headquarters. Discussion of a paper will be received during the four full months following the month of issue.

1031. Some Observations on Open Channel Flow at Small Reynolds Numbers, by Lorenz G. Straub, Edward Silberman, and Herbert C. Nelson. (EM) The paper is confined to a summarization and correlation of the results of a number of studies of open channel flow in the range of Reynolds numbers below approximately 4×10^4. Hydraulic diameter is used as the length parameter in Reynolds numbers. Smooth laminar, smooth turbulent, rough laminar, and rough turbulent flow are considered separately, as is transition from laminar to turbulent flow in smooth channels.

1032. Lateral Bracing Forces on Beams and Columns, by William Zuk. (EM) Slender beams and columns are generally braced against buckling to increase their strength. Yet little is known about the magnitude of the bracing force and it is usually assumed to be some small value based on engineering judgment. It is therefore the purpose of this paper to derive quantitatively the amounts of bracing force required for eight representative cases of beams and columns. Some of the cases are solved exactly by the direct solution of the basic differential equation whereas others are solved approximately by energy methods. In all cases, the behavior is assumed elastic. Several numerical examples are included which show that the order of magnitude of these bracing forces is small and falls within a limited range.

1033. Discussion of Proceedings Paper 694. (EM) **F. E. Richart, Jr., on 694.**

1034. The Application of Sediment-Transport Mechanics to Stable-Channel Design, by E. M. Laursen. (HY) The three requisites for a stable alluvial channel are explicitly stated and the role of sediment transport in each assessed. The similarity of the many sediment transport formulas is demonstrated and the general method of application to design illustrated. The use of these formulas as scaling relationships between different channels is advocated.

1035. Measuring Evapotranspiration from Atmospheric Data, by G. S. Benton and J. Dominitz. (HY) A method of evaluating evapotranspiration is presented, which is based on the mass balance of water vapor in the atmosphere. The method is applied to various regions of the North American continent for the calendar year, 1949, and the results are compared with hydrologic data and with an empirical method of estimating evapotranspiration. It is shown that, although accurate values of evapotranspiration can be obtained for large areas such as the entire continent, the accuracy of the method is reduced as the size of the area under consideration is decreased. The potentialities and limitations of the proposed method are evaluated.

1036. Principles of Flocculation Related to Water Treatment, by P. D. Haney. (HY) Coagulation includes addition of chemicals, their distribution, floc formation, and floc build-up. The process that leads to floc formation and build-up is termed "flocculation." Flocculation is accomplished by prolonged agitation at low velocity. Colloidal particles play an important role in the complex process of coagulation. Laboratory studies are essential for plant control and flexibility is an important aspect of plant design.

1037. A Flow Controller for Open or Closed Conduits, by V. L. Streeter. (HY) The combination of a disc moving within a profiled throat and an adjustable nonlinear resistance to support the disc against the fluid drag forces is shown to yield a principle of flow control that is infinitely variable and theoretically exact if changes in drag and discharge coefficients are neglected.

1038. Seven Exploratory Studies in Hydraulics, by H. Rouse. (HY) A series of original experiments, which were performed as the final exercise of an advanced class in laboratory techniques, is described. It includes three different aspects of jet mechanics, evaluations of the water-surface configuration at free and submerged overfalls, an analysis of wake-induced vibration, and an investigation of similarity in the flow of stratified fluids.

1039. A New Development in Flow Measurement: The Dall Flow Tube, by A. L. Jorissen. (HY) The Dall flow tube is a modified Venturi tube offering the twofold advantage of great compactness and very low head loss. The paper describes this new type of instrument and gives values for its coefficient of discharge and expansion factor (for compressible fluids). The effects of various conditions of installation are discussed.

1040. Flood Plain Aspects of River Planning, by A. M. Lunetta. (HY) The flood plains of many rivers are being increasingly regulated by various governmental agencies. No fixed method or formula exists for determining the type or manner of regulation best suited to a specific flood plain. Instead, the regulations must be based on an examination of the hydrologic, hydraulic, economic, and social aspects of the problem.

1041. Discussion of Proceedings Papers 744, 806, 826, 1040. (HY) D. M. Hersh-

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field, L. L. Weiss and W. T. Wilson closure to 744. P. Baumann closure to 806. F. A. Johnson on 826. R. L. Smith on 1040.

1042. The Effect of Pore Pressures on Stresses in Gravity Dams, by C. C. Zienkiewicz. (PO) In this paper the problem of stresses arising in a gravity dam because of the action of pore-water pressures is considered. Although the answer to this problem has been derived for a particular type of pressure distribution, the writer seeks to provide a solution for cases that often exist in practice, in which the restrictive assumptions of the known solution do not apply. The case of an idealized, triangular shaped dam is analyzed and a general elastic solution obtained, which is valid for any arbitrary type of pressure variation. Numerical answers are given to a special case in which a line of drains placed inside the dam reduces the pore pressures discontinuously. Some general conclusions are drawn from the results of these computations.

1043. History of Power Cost in New England, by Howard M. Turner. (PO) This paper traces the history of the cost of power in New England from the small water powers of the colonial period through the large industrial water powers, the growth of steam power, the development of the early hydroelectric power companies, and the growth of purchased power by industry, up to the present interconnected public utility systems. Cost figures are given, but emphasis is placed on the methods of production rather than on statistical costs.

1044. Water Supply for Texas Steam Electric Stations, by M. G. Salzman. (PO) This paper describes methods employed for circulating water systems with makeup required principally for evaporative losses. Typical examples are given of Texas plants with on-stream and off-stream reservoirs as cooling ponds, cooling towers with makeup from surface or ground-water supply, and extended circulation in artificial and extended waterways.

1045. Arch Dams: Design and Construction of Ross Dam, by C. E. Shevling and L. R. Scrivner. (PO) This paper discusses the design of the Ross Dam and its three-stepped construction. Outlined are the basic assumptions adopted for the trial-load analyses and the allowable stresses used. Included are computed stresses for the several construction stages. Timing of the various contraction joint grouting programs is also discussed.

1046. Discussion of Proccedings Papers 697, 700, 737, 895, 899, 991. (PO) L. S. Wing and R. H. Griffin closure to 697. R. W. Carlson closure to 700. J. G. Thon and G. L. Coltrin closure to 737. M. C. Bell on 895. C. D. Curran on 899. R. E. Glover on 991.

1047. Some Design Considerations for Oxidation Ponds, by E. F. Gloyna and E. R. Hermann. (SA) The demand for economical sewage disposal systems for small communities has prompted research into some of the design considerations for oxidation ponds with an eye to using the final effluent for irrigation. B. O. D. loadings up to 200 lb per acre per day are possible.

1048. Discussion of Proceedings Papers 687, 846, 885, 887. (SA) C. N. H. Fischerstrom on 687. P. R. Kriege on 846. J. S. Wiley and G. W. Pearce closure to 846. K. Kawata on 885. J. S. Wiley on 887.

1049. Engineering and Malaria Eradication, by P. N. Owens. (SA) This paper describes the steps leading up to the establishment of programs for the eradication of malaria by the countries and territories of the Americas. The responsibilities of engineers in these programs are outlined and a typical program is described. Special problems relating to the design of equipment are also discussed.

1050. Investigations of the Hydrology of Small Watersheds in Texas, by T. Twichell. (SA) With the increased importance of water, it is necessary that basic data be obtained to evaluate (1) the natural occurrence, quantity, and quality of water for a region through extended climatic cycles; (2) the interrelationships of surface and ground water; and (3) the effects of man's developments upon the water resources. The obtaining and evaluation of this basic data is given for small watersheds in Texas.

1051. Radioactive Sediments in the Tennessee River System, by J. M. Garner, Jr., and O. W. Kochtitzky. (SA) The increased use of radioactive materials poses a definite problem as to their ultimate fate. With nuclear power the engineer must be able to determine the fate of the radioactive wastes discharged into a receiving stream. The equipment and techniques for determining the concentration of radioactivity in river sediments are discussed for the area just below the Oak Ridge National Laboratory.

1052. Coagulation and Sedimentation, by J. M. DallaValle. (HY) By initially assuming a monodisperse system of particles or nuclei, the change of collisions leading to 1, 2, 3, etc., aggregated particles is computed according to the procedure used by Smoluchowski. The effect of settling is ignored by assuming the process to be very fast. The general law of settling of dilute suspensions as well as highly concentrated suspensions is discussed.

1053. The Role of Chemically Combined Oxygen in Biological Systems, by R. E. McKinney. (SA) Oxygen is the most important element in biological waste treatment systems because without oxygen there could be no growth of microorganisms or utilization of organic matter. A general discussion of the relationships of the various forms of combined oxygen to the microorganisms in biological systems is given.

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Index to Advertisers

Acker Drill Company, Inc. 145
Aero Service Corporation 127
Wm. Ainsworth & Sons, Inc. 28
Allis-Chalmers Manufacturing Company 19
American Bitumuls & Asphalt Company 123
American Bridge Division . . . . . 36 and 37
American-Marietta Company 22
American Steel & Wire Division . . . . . 16 and 17
Armco Drainage & Metal Co.. . . . . 8 and 126
Austin-Western Company 25

Baldwin-Lima-Hamilton 25
Barco Manufacturing Company 10
Bethlehem Steel Company . . . . . 14 and 128
Blaw-Knox Company 20
Boeing Airplane Company 133
Borden Metal Products Company 2
Brown & Brown, Inc. 28

Cast Iron Pipe Research Association . . . . . 34 and 35
Caterpillar Tractor Co. . . . . 12 and 13
Chicago Bridge & Iron Co. 103
Columbia-Geneva Steel Division. . . 16, 17, 26, 27, 94 and 95
Concrete Reinforcing Steel Institute. . . . . 93 and 146
Connors Steel Division, H. K. Porter Co., Inc. 137
Copperweld Steel Company 139

Eugene Dietzgen Company. 143
E. I. du Pont de Nemours & Co. Inc. 132

The Earle Gear & Machine Company 110
Eimco Corporation 21

Fairchild Aerial Surveys, Inc. 30
Fennel Instrument Corp. of America 138
Filotecnica Salmoiraghi, Inc. 146

The Flexible Road Joint Machine Company 125
Franki Foundation Company 9

Gahagan Dredging Corp. 137
The General Fireproofing Co.. 23
Griffin Wellpoint Corp. 33
W. & L. E. Gurley 129

Hughes Aircraft Company 131

Irving Subway Grating Co., Inc. . . . . 2nd cover

Jackson Vibrators, Inc.. 114

Kerrigan Iron Works Inc. . . . . 6 and 7
Keuffel & Esser Co. 116
Koh-I-Noor Pencil Co., Inc. 144
Martin P. Korn 145

Layne & Bowler, Inc. 18
The James Leffel & Co. 122
Leupold & Stevens Instruments, Inc.. 140
Lincoln Electric Company 111
Link-Belt Company 29
Lock Joint Pipe Company . . . . . 4th cover
Lone Star Cement Corporation 40

The Master Builders Co. . . . . 3rd cover
Moretrench Corporation . . . . . 4 and 5

National Clay Pipe Manufacturers, Inc. 1
National Pool Equipment Co. 38
Naylor Pipe Company 112
Northrop Aircraft, Inc. 134

The Permutit Company 113
Phillips Petroleum Co. 135
Phoenix Bridge Company 144
Pipe Linings, Inc. 31
Pittsburgh-Des Moines Steel Co. 107
Portland Cement Association 117
Pressure Concrete Co. 28

Raymond Concrete Pile Co. 24
Reynolds Metals Co. 120
H. H. Robertson Company 143
John A. Roebling's Sons Corp. 105

Servicised Products Corp. 115
Simplex Valve and Meter Company 124
S. Morgan Smith Co. 109
Solvay Process Division 139
Sonoco Products Company 141
Spencer, White & Prentis, Inc. 146
Sprague & Henwood, Inc. 119
J. S. Staedtler, Inc. 32
Standard Oil Co. (Ind.) 101
Superior Concrete Accessories, Inc. 121
Superior-Lidgerwood-Mundy Corp. 143

Tennessee Coal & Iron Division . . . 16, 17, 26, 27, 94 and 95

Union Metal Manufacturing Co. 118
United States Pipe and Foundry Co. 11
United States Steel Corporation . . . . . 15, 16, 17, 26, 27, 36, 37, 94 and 95
United States Steel Export Company . . . . . 16, 17, 26, 27, 36, 37, 94 and 95
United States Steel Supply Division . . . . . 36, 37, 94 and 95
Universal Atlas Cement Company 15

Water Seals, Inc.. 142
C. H. Wheeler Manufacturing Company 138
David White Company 135
Wild Heerbrugg Instruments, Inc. 144

Yuba Manufacturing Co. 142

Professional Services . . . . . 149, 150 and 151

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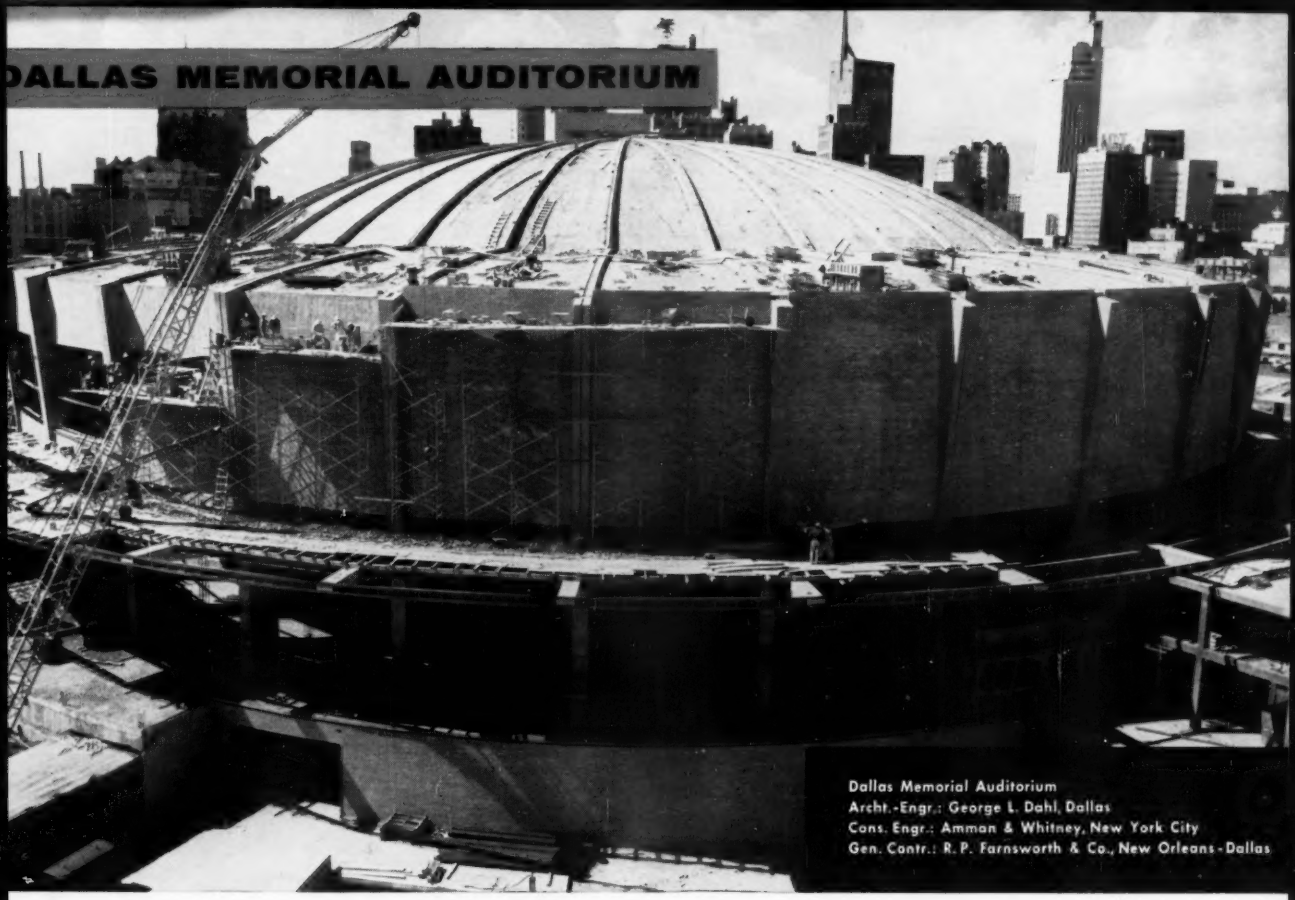

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